MACHINERY

DESIGN — CONSTRUCTION — OPERATION

Volume 37 JULY, 1931 Number 11

PRINCIPAL ARTICLES IN THIS NUMBER

FOR COMPLETE CLASSIFIED CONTENTS, SEE PAGE 896-D

Eighty-five Thousand Chromium-plated Gages Used in One Plant—Why? *By Charles O. Herb* ... 817
Dies for Making a 90-degree Elbow from Flat Stock—*By C. W. Hinman* ... 822
Why Do We Need Foremen Training?—*By C. W. Brostedt* ... 824
Permanent Molds for Zinc-alloy Castings—*By Edward Heller* ... 829
Sixty-three Holes and Slots Punched at One Stroke of the Press ... 831
Butt-welding Joints Having a Cross-section of Eighteen Square Inches—*By Malcolm Thomson* ... 833
Editorial Comment ... 836
Ingenious Mechanical Movements ... 837
Building Special Machinery on the Unit Plan ... 840
Change-gears for Cutting Special Threads—*By Felix E. Averill* ... 844
Calculating Punching and Shearing Loads—*By Robert Tweedside* ... 848
What may be Expected from Non-metallic Gears?—*By C. W. Mansur* ... 849
How to Apply Glue to Polishing Wheels—*By Robert T. Kent* ... 862
Simple Methods for Inspecting Spring Steel—*By H. J. Malafey* ... 865
What We Have Learned about Tungsten Carbide—*By Frank W. Curtis* ... 867
Machining Split Bearing Liners—*By Charles C. Tomney* ... 870
Combined Milling and Drilling Machine—*By Elmer C. Cooley* ... 872
Welding Allegheny Metal—*By G. Van Dyke* ... 875

DEPARTMENTS

Notes and Comment on Engineering Topics ... 821
Special Tools and Devices for Railway Shops ... 826
The Shop Executive and His Problems ... 828
Ideas for the Shop and Drafting-room ... 855
Design of Tools and Fixtures ... 857
Questions and Answers ... 864
New Shop Equipment ... 877

Total Distribution for June, 17,495 Copies

Product Index 202-218 Advertisers Index 221-222

PUBLISHED MONTHLY BY

THE INDUSTRIAL PRESS, 140-148 LAFAYETTE STREET, NEW YORK

ROBERT B. LUCHARS, President EDGAR A. BECKER, Vice-pres. and Treasurer ERIK OBERG, Editor FRANKLIN D. JONES, Associate Editor
CHARLES O. HERB, FREEMAN C. DUSTON and JOSEPH E. FENNO, Assistant Editors
LONDON: 52-54 High Holborn PARIS: 15 Rue Bleue

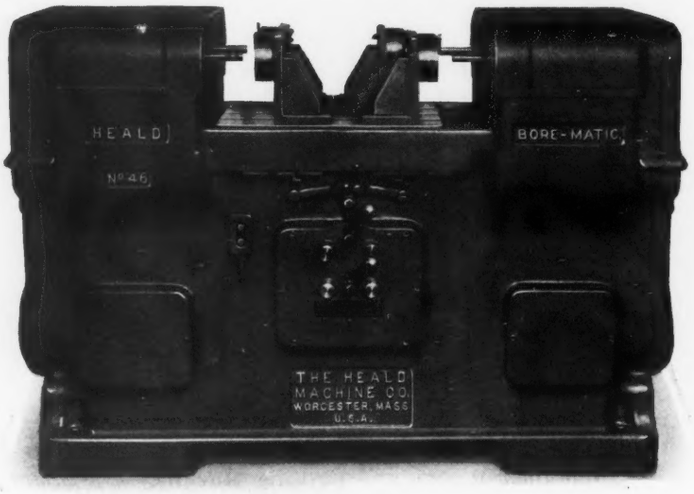
YEARLY SUBSCRIPTION: United States and Canada, $3 (two years, $5); foreign countries, $6. Single copies, 35 cents.

Changes in address must be received by the fifteenth of the month to be effective for the forthcoming issue. Send old as well as new address.

Copyright 1931 by The Industrial Press. Entered as second-class mail matter, September, 1894, at the Post Office in New York, N. Y., under the Act of March 3, 1879. Printed in the United States of America.

BORE-MATIC

—A Precision Boring Machine Possessing All Of The Required Characteristics To Secure The Most Satisfactory Results When Using Diamond Or Tungsten Carbide Tools.



THE No. 46 Bore-Matic will rough or finish bore straight, taper, blind or interrupted holes to tolerances of tenths of thousandths of an inch in any of the free cutting materials such as bronze, aluminum, fiber, bakelite, etc., as well as high-quality soft cast iron. It will also perform turning operations where conditions permit.

A FEW OPERATIONS AND SET-UPS

1—Rough or finish bore at either end of machine.

2—Rough bore at one end, finish bore at opposite end.

3—Rough or finish bore interrupted holes at either end of machine.

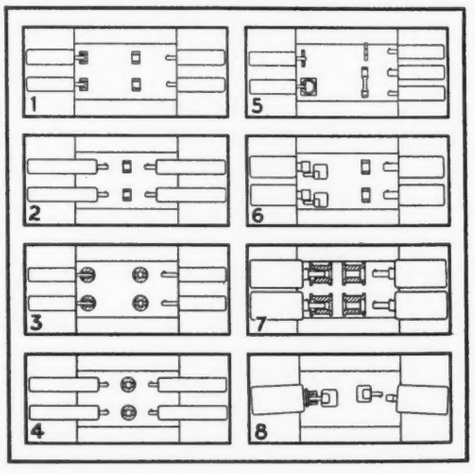
4—Rough bore interrupted hole at one end, finish bore at opposite end.

5—Rough or finish bore a variety of work to balance production.

6—Rough or finish inside and outside surfaces simultaneously.

7—Rough or finish bore stepped holes.

8—Rough or finish internal and external tapers.



Write for a Bore-Matic bulletin which shows many additional set-ups

The Heald Machine Company, Worcester, Massachusetts, U. S. A.

Branch Offices at Chicago, Cleveland, Detroit, New York, Philadelphia and Syracuse

HEALD

MACHINERY

Volume 37 NEW YORK, JULY, 1931 Number 11

Eighty-Five Thousand Chromium-Plated Gages Used in One Plant—Why?

By CHARLES O. HERB

THE chromium-plating of gages has been thought of largely as a means of salvaging when the gages wear beyond the specified usable size. However, it is a well-known fact that chromium plate wears much longer than the original finished steel gaging surfaces. This being the case, why should not these surfaces be plated when the gages are made? The cost would only be slightly higher and there would be the advantage that the gages could be used much longer before reconditioning became necessary.

It was to answer this question that the engineers of the Ford Motor Co., Dearborn, Mich., conducted an extensive investigation into the advantages obtainable by using gages plated with chromium. When it was found that in certain grinding operations, chromium-plated gages could be used 218 hours, as against 4 hours for tool-steel gages, it was decided that chromium-plated gages should be used whenever possible. The manufacturing departments had to be "sold" on this idea, but the results of hundreds of tests were convincing, and the practice has now been followed with complete success for more than two years. Furthermore, it has been adopted in all plants of the concern.

The Ford Motor Co., therefore, chromium-plates gages to lengthen their life, and thus substantially lowers inspection costs. The gage wear limit has been established as 20 per cent of the difference between the minimum and maximum dimensions. For example, if the specified tolerance on the part is 0.002 inch, the wear limit on the gage would be 0.0004 inch.

The most important economy effected by the adoption of chromium-plated gages has been in inspection costs, which have been reduced, in many cases, one-half and in some instances even more. The greatest savings have been made on applications where the specified part limits are close, because on such inspection work, the finished steel

Tremendous Reductions in Inspection Costs Have Been Made in the Ford Plants by the Use of Chromium-Plated Gages

gaging surfaces would wear quickly. Large savings have also been obtained in inspecting ground parts, where the presence of abrasive dust on the work ordinarily causes the gaging surfaces to wear rapidly.

On the average, it may be said that chromium-plated gages give ten times as long service as ordinary tool-steel gages. The huge economies effected by the use of chromium-plated gages will be apparent from the fact that more than 85,000 gages are used in the Rouge plant alone.

As chromium-plated gages wear longer, it is not necessary to have so many replacement gages on hand as before. For instance, where 30 gages of one kind are used in a department, it was formerly the practice to have 30 replacement gages on hand and from 10 to 15 gages in the tool-room being reconditioned. Now the 30 gages formerly held in reserve are unnecessary. The investment tied up in gages has, consequently, been greatly reduced, and the danger of gages rusting while in reserve has been eliminated, not to mention the saving in storage space. Fig. 1 shows typical chromium-plated gages.

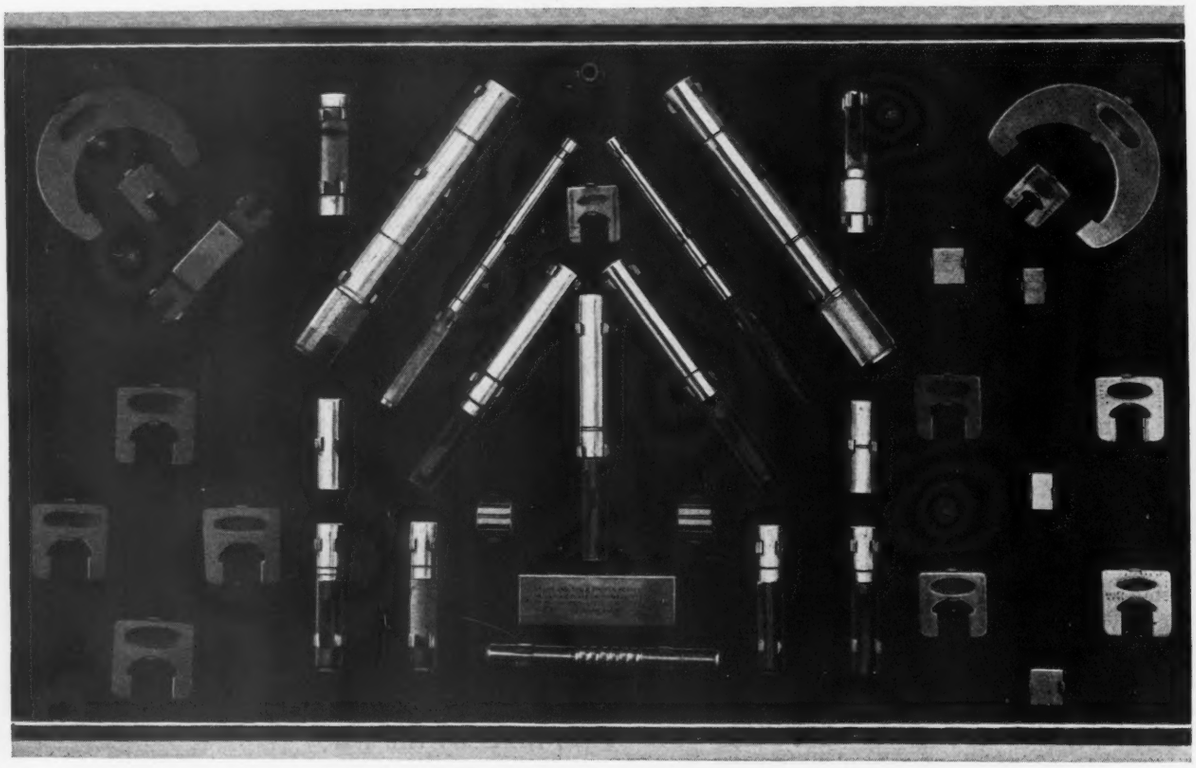


Fig. 1. A Few of the Thousands of Chromium-plated Gages Used in the Ford Plants

Heat-Treatment of Gages before Plating

The kind of steel from which the gages are made is an important consideration, in view of the fact that certain steels have a tendency to warp or crack, even after the chromium has been deposited. Cracking is likely to occur when grinding chromium-plated gages, due to the fact that the steel expands more than the chromium plate. Also, changes in temperatures may cause the gage to change its shape.

All plug and other solid gages are heat-treated to a hardness of 45 to 52 Rockwell before grinding or chromium-plating. Snap gages are hardened to from 44 to 48 Rockwell. It is important that the steel, under the chromium plate, should not be too hard, so it will "give" a little in the event that the gage is jarred.

The following is a typical heat-treatment given to tool-steel gages when maximum hardness is not desired: (1) Heat to a temperature of 1400 to 1450 degrees F.; (2) quench in oil; (3) strain-draw in oil at a temperature of 350 to 375 degrees F.; and (4) draw the temper as called for.

For chrome-vanadium steel gages, the following heat-treatment is used: (1) Heat in cyanide to 1500 degrees F.; (2) soak from 5 to 10 minutes; (3) quench in oil; (4) strain-draw in oil at a temperature of 350 to 375 degrees F.; and (5) draw the temper, if specified.

Amount Gages are Ground Under or Over Size to Receive Chromium Plating

Plug gages are ground 0.005 to 0.006 inch under size on the diameter after the heat-treatment, and then chromium is deposited to a depth of 0.005 inch all around. This allows about 0.004 inch of stock on the diameter to be removed by grinding. It is

the practice to grind a slight radius on sharp edges of plug gages, as chromium plate will tend to chip from sharp corners. Ring gages are ground 0.005 to 0.006 inch over size on the diameter and about 0.005 inch of chromium is deposited in the hole. This also allows 0.004 inch of stock to be ground from the diameter.

Snap gages are ground over size about 0.003 inch on each side and approximately 0.005 inch of chromium is deposited per side. This allows about 0.002 inch of chromium to be removed from each side.

Approximately 7000 gages are chromium-plated a month in the plating department during normal plating tank. This practice considerably reduces the time required for plating.

The hardness of the chromium plating is tested with a file. To obtain a high degree of hardness and a fine quality of plate, both of which are required to give long wear, the chromium is deposited at the rate of approximately 0.001 inch per hour.

Grinding Chromium-Plated Gages

Considerable difficulty was experienced, at first, in grinding chromium-plated gages, due to the fact that the plate peeled off. This was not the fault of the plate, but rather the result of using grinding wheels not suitable for chromium plate and incorrect grinding speeds. After experimenting with many different kinds of grinding wheels and various speeds, it was discovered that, if the grinding wheel is too hard, the chromium plate will blister and peel. The cracking of chromium plate during the grinding operation, which was previously referred to, was eliminated after carefully analyzing the heat-treatments of the steel used. An important point is to keep the grinding wheel clean at all times during the operation.

A work speed of 250 revolutions per minute is used for gages 1/4 to 1/2 inch in diameter; 170 revolutions per minute for gages 1/2 to 1 1/4 inches in diameter; 100 revolutions per minute for gages 1 1/4 to 2 1/2 inches in diameter; and 56 revolutions per minute for gages 2 1/2 to 3 1/2 inches in diameter. A 60M Abrasive wheel is used for grind-

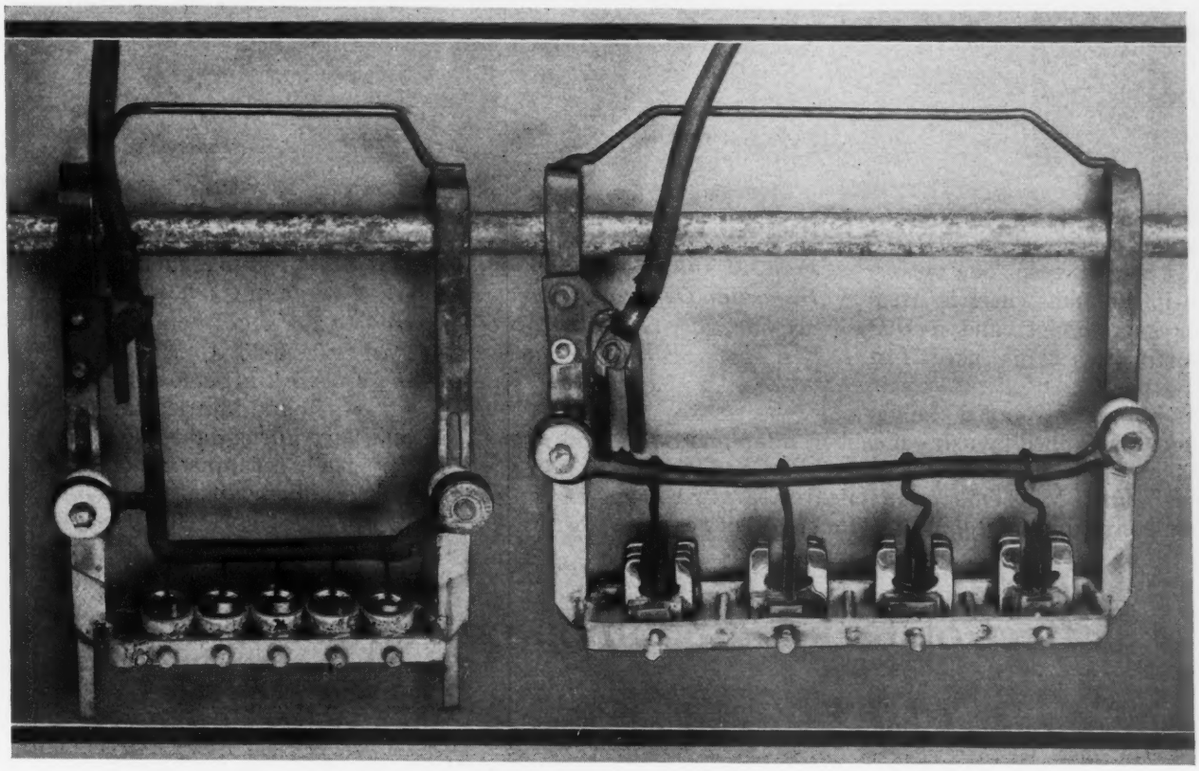


Fig. 2. Typical Fixtures Employed for Immersing Ring and Snap Gages in the Electroplating Tank

times. Fixtures of various types are used to suspend the gages in the electroplating solution, with lead anodes so fixed as to insure a uniform depth of plate. Fig. 2 shows, at the right, a fixture for holding snap gages. It is necessary that the anodes be located equidistantly between and parallel to the gaging surfaces to be chromium-plated; otherwise, the chromium deposit would be thicker on one gaging surface than on the other.

At the left in Fig. 2 is shown a fixture for holding ring gages. The anodes must extend through the hole in the ring gage; otherwise, the chromium will not be deposited on the gaging surface. Fixtures of unusual design are required for spline gages. The fixtures are suspended from bars which extend the length of the plating tank. Those surfaces of the gages that are not to be chromium-plated are covered with lacquer prior to immersion in the

Fig. 3. The First Floor of the Gage Inspection Department in which Gages are Carefully Checked before They are Sent to the Shop

ing plug gages. The softer 46-I Oxaluma wheel is used for snap gages, and a DK Norton wheel is used for ring gages.

Chromium-plated plug gages are lapped by using a cast-iron lap and S F X Washington Mills emery for roughing, and S F12X Washington Mills emery for finishing. Sixty 1-inch diameter plug gages, 2 1/4 inches long, can be lapped to an accuracy of plus or minus 0.00002 inch during an eight-hour day. From 0.00025 to 0.0003 inch of stock is removed by lapping. Round knurled laps are used on ring gages, and flat knurled laps on snap gages.

All gages are given a careful inspection by means of equipment such as illustrated in Fig. 3 before being placed into service.

Effect of Pickling Solution on Hardened Tools

By C. G. WILLIAMS

From a review of articles appearing in technical publications, it would seem that in pickling hardened steel parts, such as the dies referred to on page 696 of the Questions and Answers section of May MACHINERY, the hydrogen released from the bath will act upon the steel in such a manner as to cause embrittlement. This results from the absorption of hydrogen in the inter-crystalline cement between the metallic grains.

Experiments have shown that any electro-deposited metal is in a state of stress, the deposited metal being in tension. This state would cause the die to expand slightly at the open section opposite the point *A* shown in the illustration on page 696 of May MACHINERY. The hydrogen embrittlement of the metal at *A* would so weaken the die as to cause it to fall apart or, when ruptured by the action of the plating, to be held together only by the thin section of the plating.

As nickel-plating has an internal tensile stress of about 26,000 pounds per square inch, it would probably cause the die to rupture after the embrittlement. If the dies can be heated in a salt bath for hardening so that the pickling process can be eliminated, it is believed that all troubles from broken dies would cease. In tempering in a salt bath, the slight amount of salt retained upon the metal will eliminate any oxidizing of the iron from the oxygen in the air. Therefore, no scale will be formed and there will be no need for the pickling process. The chances are that, with the hydrogen embrittlement elements lacking, no more trouble will be encountered from fracturing of the dies after they have been plated.

* * *

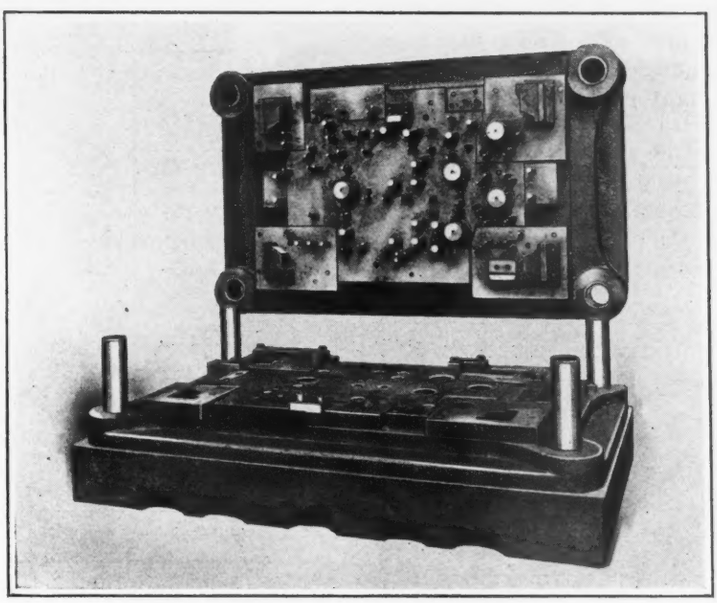
In 1930, the automobile manufacturing industry used 57 per cent of all the strip steel manufactured in the United States, 30 per cent of the bar stock, 26 per cent of the sheet steel, and 53 per cent of the malleable iron. In addition, the industry consumed 69 per cent of all the plate glass made, as well as 30 per cent of the nickel and 26 per cent of the lead produced.

Notes and Comment on Engineering Topics

The establishment of a single Court of Patent Appeals is proposed by the American Engineering Council in a report of its patents committee, of which Edwin J. Prindle, former president of the New York Patent Law Association, is chairman. Such a court, it is believed, would protect both the patentee and the public from the enormous financial waste incident to the present procedure. This Court of Patent Appeals, sitting at Washington, would have final jurisdiction of all appeals from the District Courts of the United States and the Supreme Court in the District of Columbia.

Oil-electric locomotives are beginning to run into considerable size. An 800-horsepower locomotive of this type has recently been furnished by the General Electric Co. and the Ingersoll-Rand Co. to the Erie Railroad Co.'s shops at Akron, Ohio. This locomotive weighs 230,000 pounds. It is designed for switching and transfer service, and is capable of a maximum speed of 40 miles per hour. A tractive force of 28,000 pounds is available at the continuous rating, and 69,000 pounds at starting.

It is just a little over fifty years ago that Thomas A. Edison built the first electric railroad in the United States. This experimental railroad was built and operated at Menlo Park, N. J., and extended for a third of a mile over the meadowland near the Edison laboratory. The entire equipment was extremely crude, but it worked. In 1882 Edison built a more pretentious electric railway at Menlo Park, three miles in length, with sidings, curves, and trestles. The locomotive was more business-like, having cab, bell, and cowcatcher. This demonstration was built to convince the late Henry Villard, president of the Northern Pacific Railroad, that the mountain divisions of his road could be operated electrically. Ten engineers of the Northern Pacific Railroad spent three days in inspecting the equipment, but reported unanimously that the idea was impossible and foolish. An engineer of the Pennsylvania Railroad stated that to electrify the line between New York and Philadelphia would never be possible. Today, the entire mountain divisions of two of the Pacific roads have been electrified.



Die Built by Peter Gray & Sons, Inc., East Cambridge, Mass., for Stamping a Radiola Chassis in One Operation—Courtesy of American Gas Association

---

Dallas, Texas, probably leads in the erection of welded office buildings. Some time ago, the Dallas Power & Light Co. erected a nineteen-story welded building, which, up to the present time, has been the highest structure of this kind. The Dallas Gas Co., however, is erecting a twenty-two-story building of welded construction; fourteen stories have been completed, and provision has been made for erecting the remaining eight stories later. Ninety-two municipalities throughout the United States have now incorporated sections in their building codes allowing the use of welding in building construction.

Exact agreement of operating speeds of two or more non-synchronous electric motors can now be maintained by means of a new control system announced by the General Electric Co. This system, in which "selsyns" (small self-synchronizing motors) play a fundamental part, is expected to be of great advantage in industrial applications where synchronous operation of different machines or devices is essential.

Dies for Making a 90-Degree Elbow from Flat Stock

In the Final Drawing Operation, One End of the Elbow is Formed by Forcing a Steel Ball Through One Side of the Drawn Shell

By C. W. HINMAN, Tool Designer, Kobzy Tool Co., Chicago, Ill.

FIVE separate dies are required for making the drain elbow shown at the bottom of Fig. 1. Another operation, not shown, that of tapping a thread in the flanged end, is accomplished by means of a collapsible tap, the elbow being held in a simple fixture for this work.

The dies used for the first and second draws are of the usual design and need not be described here. The forming of the opening *A*, however, proved a difficult problem, and many experiments were carried out before successful results were obtained. The conditions under which this opening was to be formed were such that the walls of the raised portion *B* had to be thrown outward by a punch operating from the inside of the elbow. The size of this punch was limited to a diameter of about 1 11/16 inches by the inside diameter of the shell, allowing very little space for cams to be used for forcing an auxiliary punch through the raised portion.

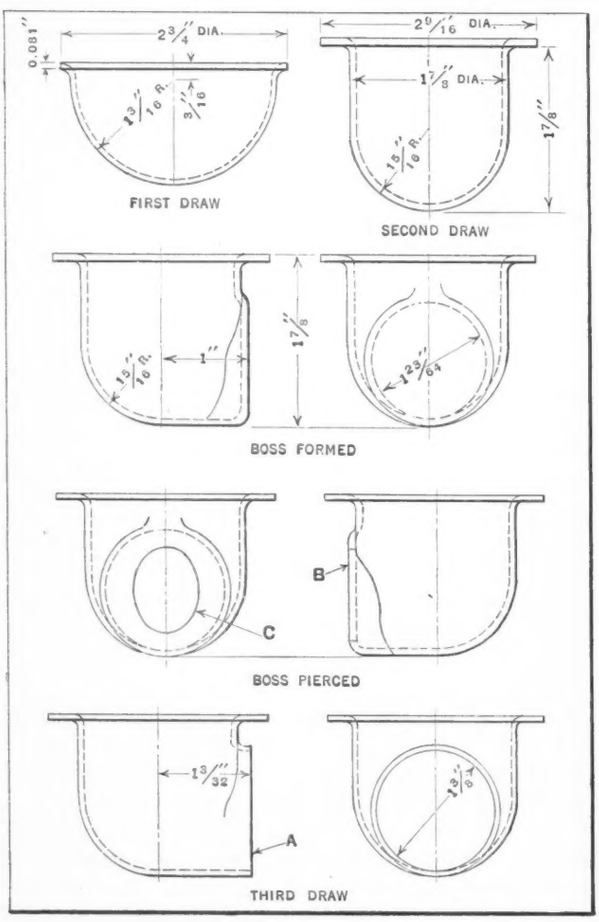


Fig. 1. Successive Steps in Making a 90-degree Elbow

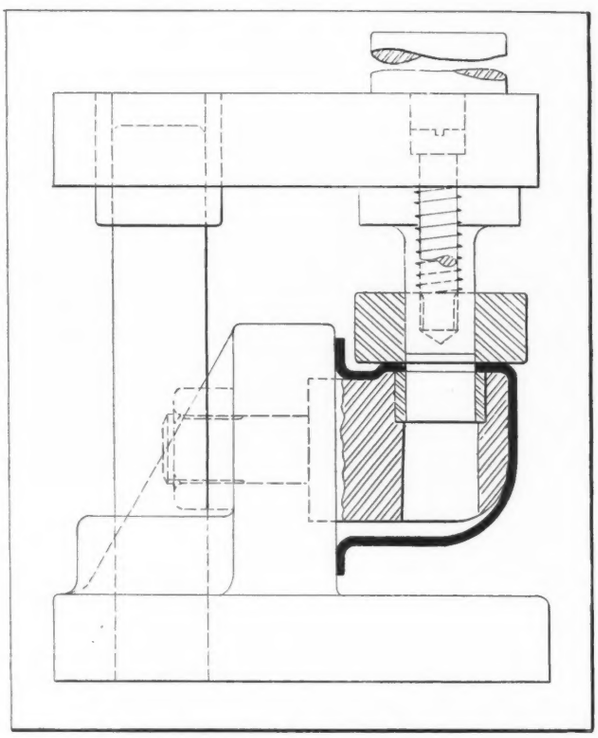


Fig. 2. Type of Die Used for Piercing and Forming the Raised Portion at the Small End of the Elbow

Finally, the punch and die shown in Fig. 3 was made. Here a hardened steel ball having the same diameter as the inside of the opening is employed for forming the opening. The face of the punch in this tool has a peculiar curved surface designed to force the ball horizontally, opening the oval hole *C* (Fig. 1) in the raised portion of the work and forcing the walls outward until they assume the desired shape. When the ball passes through the elbow, it is free to roll on down through the pipe *D* in the back of the die-shoe. Through this pipe the ball is guided downward through the bolster plate, finally returning to a small tray at the front of the press in a convenient position to be used again. The same ball is used for the entire lot of elbows.

The shell is secured in this die by means of the swinging gate *E*, which is locked in place by a cam-lever (not shown). The finished piece is easily removed from the die by hand after the cam-lever is

released and the swinging gate opened. The work will not stick in the die, because the die opening is made large enough to prevent this, and at the same time it is small enough so that a smooth even wall is formed by the ball.

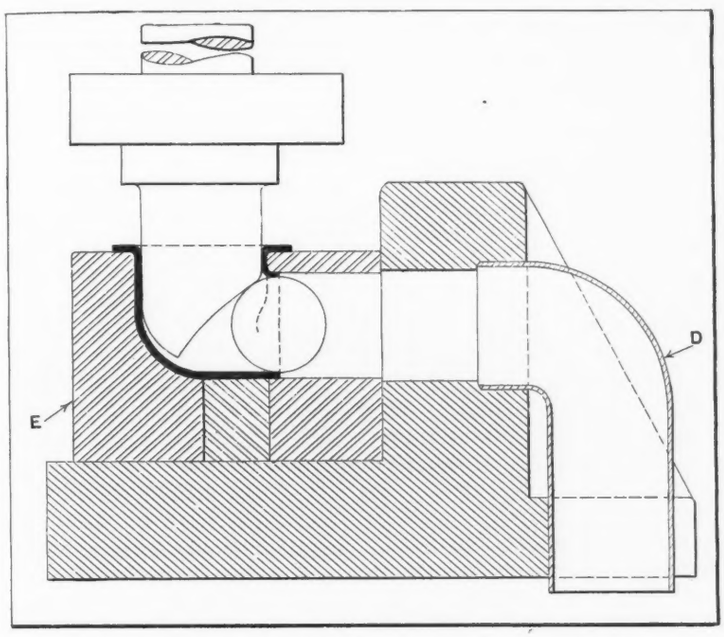


Fig. 3. Die in which a Steel Ball is Used for Drawing the Small End of the Elbow

The die shown in Fig. 2 is used for piercing the elliptical hole in the raised portion of the shell. For raising the portion at *B*, Fig. 1, the same type of die is used, but the piercing members are replaced by forming tools.

Die for Punching Radial Holes in Cup

By CHARLES H. WILLEY
Superintendent of Manufacturing
Hoyt Electrical Instrument Works, Penacock, N. H.

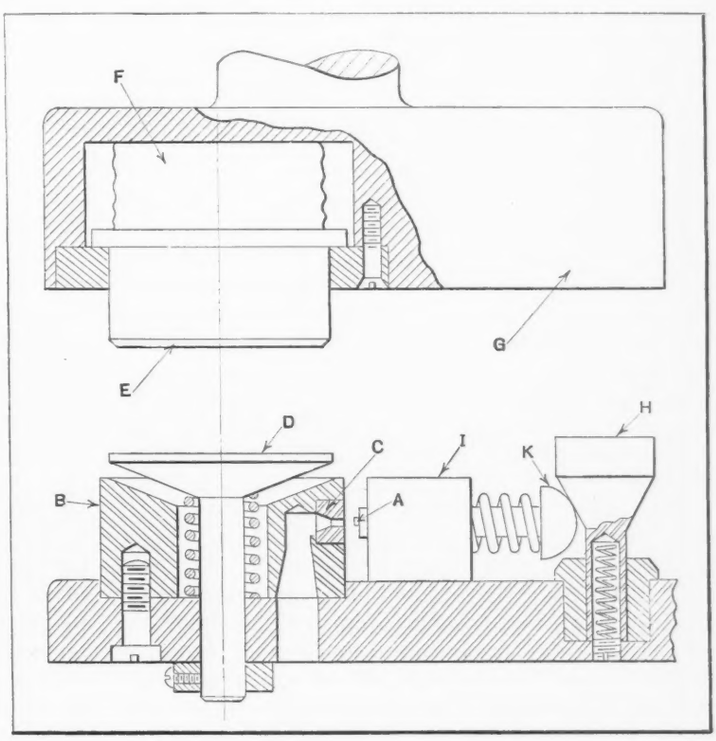
The design of a die for punching two 1/8-inch radial holes through the walls of a drawn brass case or cup is shown diagrammatically in the accompanying illustration. Over 25,000 pieces have been produced on a die of this kind without any tool repair cost or attention other than the replacement of the small punches, one of which is shown at *A*. The replacement of these punches is an easy matter, as they are simply mounted in the ends of the plungers *K*.

The case to be punched is placed over the mandrel *B* in which the dies *C* are mounted. The bottom of the case or work rests on the ejector *D*. When the ram descends, the plunger *E* forces the work down into place so that member *D* is seated in member *B*. Continued downward movement of the ram causes the rubber compression pad *F* to be compressed as plunger *E* recedes, while the holder *G*, coming in contact with the plungers *H*, causes the punches *A* to advance inward and pierce the two holes in the work.

On the up stroke of the ram, the various parts are returned to their original positions by the rubber pad and the springs. The ejector *D* raises the work so that it can be easily removed. Although the block *I* in which the piercing punches are mounted appears to be rectangular, it is really segment-shaped or, in other words, shaped like a section of a ring, and holds two plungers *K*, only one of which is shown in the illustration. As a matter of fact, it could be made in the form of a complete ring with the proper amount of space between the inner face and the member *B* to provide the necessary clearance for the work. With a ring of this type and a member *G* of sufficient size, punches could be located in any radial position around the entire circumference of the mandrel *B*. Both of the punches used are like the one shown at *A*, and are actuated by the same type of plunger *H*.

* * *

Don't criticize unless you can suggest a better way of doing the job.



Die for Punching Radial Holes in Brass Cup

Why Do We Need Foremen Training?

The Foreman's Job is Not so Simple as Managers in the Past have been Inclined to Believe. The Problems that the Foreman Must Solve Make Adequate Training Necessary

By C. W. BROSTEDT, Production Manager
Ritter Dental Mfg. Co., Inc., Rochester, N. Y.

THE foreman's job is to produce a profit for the management. To do this, he must coordinate three elements—men, machinery, and materials. Men are variable; no two are exactly alike. To administer his department justly, as between the firm and employes, is a man-sized problem. Machinery and equipment present another difficult problem. He may face this problem either in the attitude of hireling or proprietor, depending upon his traits and the training he has received. Material may be to him simply bars, sheets, and parts, or it may take the form of dollars in the making. Avoidable waste may be a subject that he passes over lightly or it may mean to him lost profits and waste of human energy.

During the present business depression, sad lessons have been learned in many plants and serious thought has been given to what should be expected of foremen. But will the foremen measure up to the standard that is laid down? If not, are you going to scrap your investment in them to experiment with strangers or are you going to train them—and if so, how?

What is the usual process of selecting a foreman? A vacancy occurs, candidates are considered, and John Smith is selected, because he is a good mechanic, is ingenious, has vision, and mixes well with people; is sober, industrious, and honest; has good health, acceptable bearing, sound judgment, and ambition; and is believed to have mentality capable of development.

These qualifications single him out as desirable material. He is assured that he will be given all the assistance possible to help him succeed, and admonished to be frank in seeking information that will guide him. He has had an opportunity to secure some knowledge of his duties during his past work, his intentions are good, and he is made foreman.

Time passes. The pressure of urgent duties takes his superior's time, so that John does not have the opportunity for frank discussions with him; he may exchange confidences with his brother foremen who may or may not be able to assist him; what little time the executive can spare is devoted to giving urgent instructions; the hope that the day will come when a candid talk with his superior "will iron out the difficulties" does not materialize.

The executive, in the meantime, has become quite accustomed to thinking of John as foreman, and is holding him strictly accountable for errors in judgment and performance. Then comes a day when it is evident that something is lacking. John has not made good. Generally speaking, very little thought is given to the reasons for his lack of progress or judgment. He may be condemned for lack of ability, when the true cause is lack of perspective or understanding of what is required of him.

The foreman in the present-day manufacturing plant must be regarded as the manager of his department. The machinery, tools, and equipment entrusted to him may easily be worth $50,000—sometimes very much more. The work in process may be worth an equal amount. Assume that twenty men are employed in his department, with an average annual wage of $1500. This means an annual payroll of $30,000. All told, the foreman is responsible for a large share of the firm's money, and it is his job to produce a return on this investment and to conserve the assets. Is it not evident, then, that the foreman needs to be properly trained for his job if he is to be capable of discharging his duties to the best interests of the firm?

Let us consider the investment intrusted to the foreman. The machinery, tools, and equipment in his department may easily be worth $50,000. The work in process may be worth an equal amount. Supplies, repairs, power, heat, light, and factory space may be worth $12,000 a year. Assume that there are twenty men employed in his department with an average annual wage of $1500; this means a payroll of $30,000. All told, the foreman handles $142,000 of the firm's money. It is his job to produce a return on this investment and to conserve the assets. A tidy sum of money is placed in the hands of a person without skill in administration.

The trust is his only as long as he maintains the expected return, and he is constantly under the supervision of an executive who warns him of danger. However, he is not made to feel that he is a financial agent. Nevertheless, if John Smith's department were "set up" on a financial basis—if he felt that he was handling unseen dollars—would not his job impress him in quite a different way, and would it not be to the advantage of his employer?

A source of bewilderment to the new foreman is the departmental structure of the modern industrial plant. Why are there industrial, engineering, employment, safety, welfare, cost, statistical, and inspection departments? How are these functions of management explained to the foreman—if at all? Does John Smith have the impression that these departments are created to render him a service that he does not have the time or the apti-

tude to perform? Or does he consider them as annoyances to pester him into submission to a program with which he may be unfamiliar and, consequently, rather unsympathetic?

In a recent issue of a trade journal, a workman is quoted as follows: "There are more white-collared guys walking up and down this aisle with slips of paper in their hands than there are workmen." Suppose John Smith had made this remark just before he was promoted. Suppose that after he had started on his new job, he had the backbone to put up a battle to "find out." Do you wonder at the lack of "coordination" that John is assumed to have exhibited?

Most Good Mechanics are not Able to Handle Men without Some Guidance

Consider the employes that a foreman has to deal with. Representatives from several nations will be found in the department—French, Italian, English, Swedish, and German workers are interspersed with native American stock. There is a confusion of tongues, clashing ideas, varying temperaments, and national pride, hatreds, and jealousies. Assume that John Smith is an American of old stock, with all the desirable traits that we associate with that conception. It is not difficult to picture his problem of administering to a group such as outlined. Is there any wonder that he may not develop a foreman's qualities as rapidly as had been hoped for? There are cases where exceptional men will succeed under these conditions without training, but they are few.

When a new machine, tool, or piece of equipment is installed, extreme care is taken to furnish adequate instructions for its proper operation and maintenance. How much instruction in handling men is given to the foreman? Would not some instruction, based on what we know of practical psychology, be of value? It seems self-evident that the foreman should know "why we behave like human beings." He is confronted daily with many problems that would be easier of solution if he understood the reasons for disagreeable human moods and how to counter them. Incidentally, such knowledge applied to himself, would be priceless at times.

The Foreman Needs a Clear Conception of the Organization as a Whole

An understanding of the organization as a whole and its work will greatly assist a foreman. Most men have a strain of sympathetic understanding and like to help a person who is struggling with difficulties. They are willing to cheer the person who is showing sterling qualities, provided they understand the nature of the struggle. How often does one hear the remark in the shop, with reference to executives: "Would a soft cushion in a swivel chair be an agony?" If a few talks were given to the foremen on sales difficulties, competition, and the risk of producing articles that may be superseded over night, they might concede that the soft cushions at times may be lined with giant tacks. This may also result in minimizing the foreman's own troubles; there would be a plain man-to-man understanding that would be of great value to the organization.

The next step in industrial development is waste elimination in all forms, not omitting waste in overhead expense. It may be that departments should be consolidated. Have the foremen been trained to assume additional responsibilities without the danger of a physical breakdown? The properly trained foreman, when given added responsibilities, will begin to handle his work by dividing a part of his other duties among his subordinates. He will understand that the change has been made because of the keenness of competition and that he can prevent competition from ousting him from his job (and his firm from the field) only by willingness and ability to assume any additional responsibility that may be put upon him.

Finally, it should be considered that the foremen are in the front ranks of the production service, just as the salesmen are in the front ranks of the distribution service. Can management afford to have the foremen any less familiar with the company's plans and expectations than the salesmen? Are there not untapped resources lying more or less dormant in the reservoir of human activity represented by a company's foremen? The writer's counsel is: Try to tap these resources. A pleasant surprise often awaits a forward-looking and broad-minded management.

* * *

The Engineering Index

Through the initiative of the American Society of Mechanical Engineers. 29 W. 39th St.. New York City. the Engineering Index was started somewhat over three years ago as a service to the engineering field. Briefly, the work of the Engineering Index consists of reviewing and indexing the engineering literature of the entire world. About 1800 engineering, scientific, technical, and trade publications are regularly received and indexed.

A brief abstract of each article indexed, together with a statement of the original source is printed on standard index cards, which are distributed weekly to subscribers for the Index. Approximately 50,000 index cards are published each year by a staff of engineers capable of translating the seventeen foreign languages in which the publications are printed.

The Index is available, not only on cards, but also in annual volumes. The card service is arranged in 223 divisions, one or more of which may be subscribed to separately. There are divisions for all leading industries, for important processes, and for every branch of applied engineering science. The annual volumes cover over 2000 large pages, including an index of authors with about 20,000 names. MACHINERY is one of the publications regularly indexed in the Engineering Index.

Special Tools and Devices for Railway Shops

Equipment Employed in Locomotive Repair Shops, Selected by Railway Shop Superintendents and Foremen as Good Examples of Labor-Saving Devices

Pneumatic Rod and Bar Stock Cutter

By H. H. HENSON, Foreman, Machine and Erecting Shops Southern Railway Co.

In the accompanying illustration is shown a pneumatically operated shear which will cut off bar stock from 1/8 inch to 1 1/4 inches thick by 5 inches wide, and shear rods or bolts from 1/4 inch up to 2 inches in diameter without changing the dies or shears. The frame *D* and shear-holders *K* are riveted together by 1-inch rivets. The shear-holders and the levers *A* are heavy steel forgings. Reinforcing ribs are forged on the back of levers *A* to prevent lateral distortion when cutting off bar or rod stock. The distance between the fulcrum pin *H* and the articulated joint at *E* is 58 inches for each of the levers. The shear blades are 8 inches long. The frame *D* is about 11 feet long, and the air cylinder that actuates the levers is 18 inches in diameter and 12 inches long.

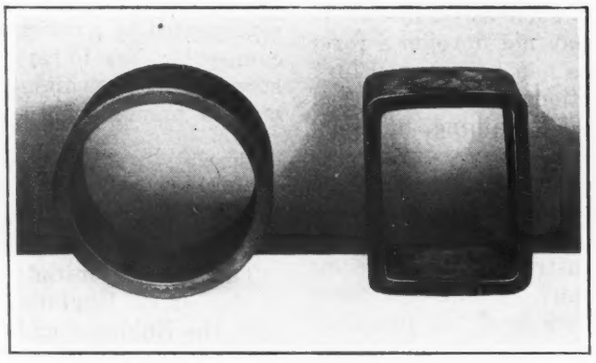
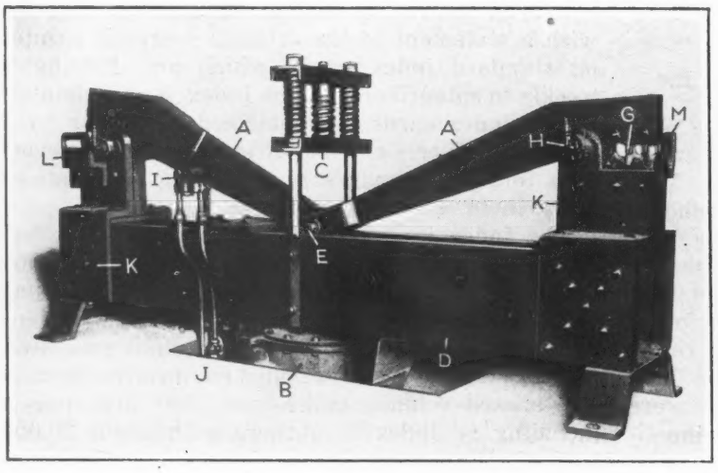


Fig. 1. Spring Buckles are Produced in One Operation from Pieces of Round Steel Tubing

The compressed air for the cylinder *B*, which is located in a pit below the floor level, is controlled by the three-way air valve *I*. Air at a pressure of about 100 pounds per square inch will cut or shear the largest sizes or pieces of iron or steel that the machine is designed to handle. At *L* is shown the guard for the flat stock shears, and at *M* is shown the guard for the round stock or rod cutters *G*. The three slots in the rod shears are 1 1/32, 1 17/32, and 2 1/32 inches in diameter, the largest size being next to the fulcrum pin *H*. The spring buffer is shown at *C*, and the cut-off valve at *J*.



Pneumatically Operated Rod and Bar Stock Cutter

Spring Buckles Forged from Round Tubing

Locomotive spring buckles are forged from seamless steel tubing in the Montreal shops of the Canadian National Railways. Fig. 1 shows, at the right, a finished buckle, and at the left, a piece of tubing similar to that from which it was produced.

The practice is to heat the piece of tubing to 1500 degrees F. in an electric furnace, place it in the hydraulic press shown in Fig. 2, slip a rectangular man-

Fig. 2. Forging a Spring Buckle from Round Tubing in a Hydraulic Press

drel *A* into the heated tubing and place a hammer *B* on top. Then, when the horizontal ram of the press moves inward and the vertical ram moves downward, the tubing is shaped to fit the mandrel. A sledge hammer is afterward used to loosen the part from the mandrel.

This method of forging the buckles is a striking advance over the former practice, and has resulted in large economies. The previous method was to forge a flat bar into the required rectangular shape and then weld the ends of the bar together. The present method saves a great deal of time and is much cheaper. O. H.

* * *

The Railroads Must Know their Materials

In a paper on "Metallurgy in the Railroad Field" by Professor A. E. White, director of engineering research at the University of Michigan, read before the Birmingham meeting of the American Society of Mechanical Engineers, the author referred to the fact that railroad companies have been criticized for their apparent backwardness in the adoption of materials that have been developed or have come into common use, particularly in the automotive field, during the last twenty years. They also have been criticized for not taking advantage of the possibilities of increasing strength and other physical properties by heat-treatment, in order to reduce weights and sections. These criticisms have not taken into account the fact that the byword of railroad transportation is "safety." In view of what the results of any other policy would be, such a conservative attitude is certainly to be commended.

When it is considered that a person is practically as safe on a railroad train, even though that train may be speeding through the night at the rate of sixty miles per hour or more, as at home, it is easy to appreciate what the railroads have done in assuring their passengers the maximum degree of safety. How correct this statement is may be appreciated by the fact that only about four or five train accidents occur on Class 1 railroads in the United States per million locomotive miles and that all of these do not result in injury or death. The railroad systems of the United States have evidently done wisely to adopt this policy of "safety first," and it is easy to understand the underlying causes for their conservatism toward changes in materials.

* * *

Statistics of Industrial Buying

The Industrial Machinery Division of the Department of Commerce, Washington, D. C., of which W. H. Rastall is chief, has prepared some valuable statistical information and maps covering the purchasing power of industrial plants, by counties, throughout the United States, including those counties that buy materials, fuel, and power for industrial production to an amount of $20,000,000 a year or more. The maps are prepared to give a graphical illustration of the information contained in the statistical tables, showing, by different forms of cross-sectioning, those counties that have a purchasing power of less than $20,000,000, those that purchase from $20,000,000 to $50,000,000; from $50,000,000 to $100,000,000; from $100,000,000 to $500,000,000, and $500,000,000 and over.

Cook County, Ill. (Chicago), is shown to have the highest purchasing power of any county in the country, the figure for this county rising to over $2,000,000,000; Philadelphia County, Pa., is a close second with $1,861,500,000, while New York County accounts for $1,861,000,000. New York City as a whole, however, leads the list with a total industrial purchasing power of $2,854,000,000; Wayne County, Mich. (Detroit) accounts for $1,247,000,000, and the city of St. Louis for $937,000,000, Allegheny County, Pa. (Pittsburgh) following with $714,000,000.

It is of interest to note that the total cost of materials, fuel, and power used in industrial production in the 237 counties in the United States that expend over $20,000,000 annually each, accounts for 81 per cent of the total throughout the country.

* * *

A Belt Dressing for Rubber Belts

Up to the present time manufacturers of rubber belts have generally advised against the use of belt dressings for belts of this kind. The Diamond Rubber Co., Inc., Akron, Ohio, now announces that a new belt dressing has been prepared containing no oil or grease and no chemicals that would be harmful either to the rubber belts or to the pulleys. This dressing is available in stick form. It is not inflammable and is effective for a long period of time after application.

The Shop Executive and His Problems

Superintendents and Foremen are Invited to Exchange Ideas on Problems of Shop Management and Employe Relations

Referring to the question raised on page 658 of May MACHINERY, I am firmly of the opinion that all employes of approximately equal rank should be treated alike. In the case of telephone calls, for example, I would extend this privilege to office and shop executives alike. All other employes, both in office and shop, should have the permission of their supervisor to make an outgoing call and should have only a message delivered on an incoming call. In this way, any abuse on the part of some one employe would be on record, while, at the same time, occasional emergency use would not be denied others.

CHARLES KLYNE

Another Successful Suggestion System

On page 658 of May MACHINERY, the subject of giving due credit for ideas to the man to whom the credit belongs is brought up. This matter is taken care of in a plant with which the writer is familiar in a very satisfactory manner. The company does not pay for suggestions, but believes in encouraging and acknowledging suggestions, giving due credit to those who make them. The foreman or the supervisor notifies the office whenever a man suggests a new method of doing a job. A printed form, specially prepared for the purpose, is then filled out and sent to the man, thanking him for his interest and assuring him that the company appreciates his efforts in improving methods.

It may be thought that this would not induce the men to contribute their ideas, but the facts prove otherwise. A list of the suggestions is kept on file and is frequently referred to when a question of increase in pay or promotion comes up. The men in the shop know this and are eager to get their name on this list as often as possible. Thus new ideas and methods are stimulated.

Personally, I am in favor of direct compensation for adopted ideas, but admit that there are many good points in the system outlined. The results have been very satisfactory all around.

CHARLES R. WHITEHOUSE

Keeping in Touch With New Developments

During the last twenty years, a copy of MACHINERY has always been on my desk where I could refer to it at any time. I have acquired a fair reputation for being able to select the right machine and tools for different manufacturing processes and for making new products when introduced. I owe this reputation to my familiarity with the machines and tools described and advertised in publications such as MACHINERY.

R. B. BEAUCHAMP
107 S. Center Road
South Euclid, Ohio

How Can a Foreman Best Instruct His Men?

Commenting on the article on page 591 of April MACHINERY, I would warn against the danger of making it appear as if all the brains of the department were concentrated in one man. I believe that the workmen should be clearly told what is to be done, but a good man should be left to decide for himself how he is to do it. Of course, if the job happens to be unusual, or particularly difficult, the man might be asked to report on how he would propose to do it before he actually starts on the work. If he has an acceptable method, approve it; otherwise, help him to work out a satisfactory method. After all, there is often more than one way of doing a good job, and all the ability in the shop ought to be made use of.

LEWIS J. YAPP

Experience as foreman for the last twenty-eight years in various engineering works, leads me to express my views on the subject published on page 591 of April MACHINERY. In giving instructions, avoid, if possible, saying "Do not do it that way"; instead, say "Do it this way. We have found this the best method."

A friend of mine who makes jigs, fixtures, and dies, has two shops on opposite sides of the street. He says that he always gets better results from one shop than he does from the other, simply because one of his foremen is an unusually capable instructor, who is able to arouse the enthusiasm and cooperation of his men. Always give the men a chance to express their own ideas as to how work should be done. If the ideas do not appear satisfactory, explain why.

Generally speaking, it is not enough that a man knows how to do a certain job—he ought to know why he does it. This gives him an added interest in his work, and when a man is interested in a job, he generally handles it much more efficiently.

A. EYLES

Permanent Molds for Zinc-Alloy Castings

By EDWARD HELLER

TWO permanent molds for producing small zinc-alloy castings are shown in the accompanying illustrations. The castings produced are shown at *A* and *B* in the upper right-hand corner of Fig. 1. The permanent mold method of casting aluminum, zinc alloys, and other non-ferrous metals resembles die-casting in that the mold is used over and over again, whereas in sand mold casting a new mold is required for every piece. The metal enters the permanent mold by gravity alone, as in the case of sand molds, while in the die-casting process, the metal is forced into the mold or die by external pressure.

Permanent molds produce castings that are fairly accurate, although not quite so accurate as die-castings. The work can be held to size within 0.010 inch, or within 1/64 inch under more unfavorable conditions, in permanent molds, while die-cast products can be held to size within 0.001 inch. The two castings *A* and *B*, Fig. 1, are fastened together by means of flat-head screws. These castings come from the molds ready for use, except for the tapped threads *C* in the four holes of part *B*.

The assembled castings are used in connection with the pineapple-growing industry. The cup formed by the castings *A* and *B* is kept filled with a poisonous liquid that serves to exterminate a certain pest, and must therefore be kept liquid-tight. The castings have to be made up as the need for them arises in an agricultural region, which is

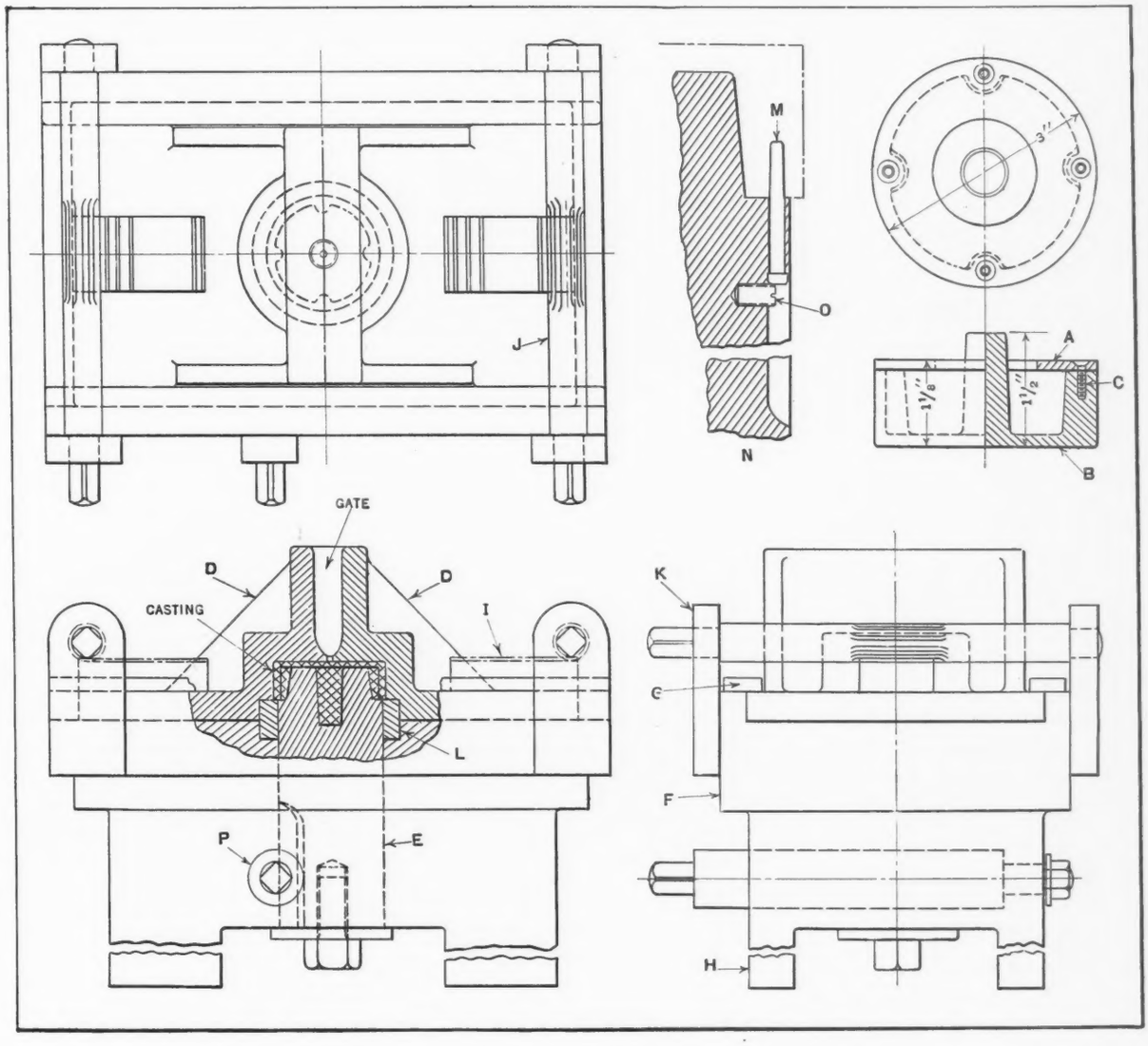


Fig. 1. Permanent Mold for Producing Zinc-alloy Casting Shown at B

located far from machine shops and foundries. Of the three methods generally used for making castings, the permanent mold method produces the soundest job, and its simplicity permits the castings to be made anywhere by an intelligent workman.

Design of Permanent Molds

The principal members of the mold, Fig. 1, for making the body *B* consist of two slides *D*, which when slid together, form the cavity for molding the outer part of the casting, and the core *E* which forms the cavity in the casting. The two slides are fitted into the base *F*, where they are held in place by the cold-rolled steel gibs *G*. The base is cast with four legs *H* to provide sufficient space to permit the core *E* to be withdrawn.

Short racks *I* are fastened to the tops of the slides *D*. These racks mesh with the pinions on shafts *J*, which are mounted in the bearings *K* fastened to base *F*. The shafts *J* are provided with square ends which permit them to be rotated by means of a crank. A ring *L* serves as a pilot for aligning the two halves of the slides *D*. The cavity thus formed by the slides is kept concentric with the core *E*.

The main core carries four small core-pins *M*, shown in the enlarged cross-section view at *N*, Fig. 1. These core-pins form the holes at *C* that are subsequently tapped. The pin ends must be inserted in the main core in such a way that they will not come out when the core is pulled out of the casting, and yet they must be easily removable for replacement and for polishing—an operation that must be performed after every few hundred castings have been made. To take out the pins *M*, the small set-screws *O* are removed and the pins driven out into the grooves, from which they fall out. The core *E* is manipulated by the pinion and shaft *P* which engages the rack teeth milled in the body of the core shaft.

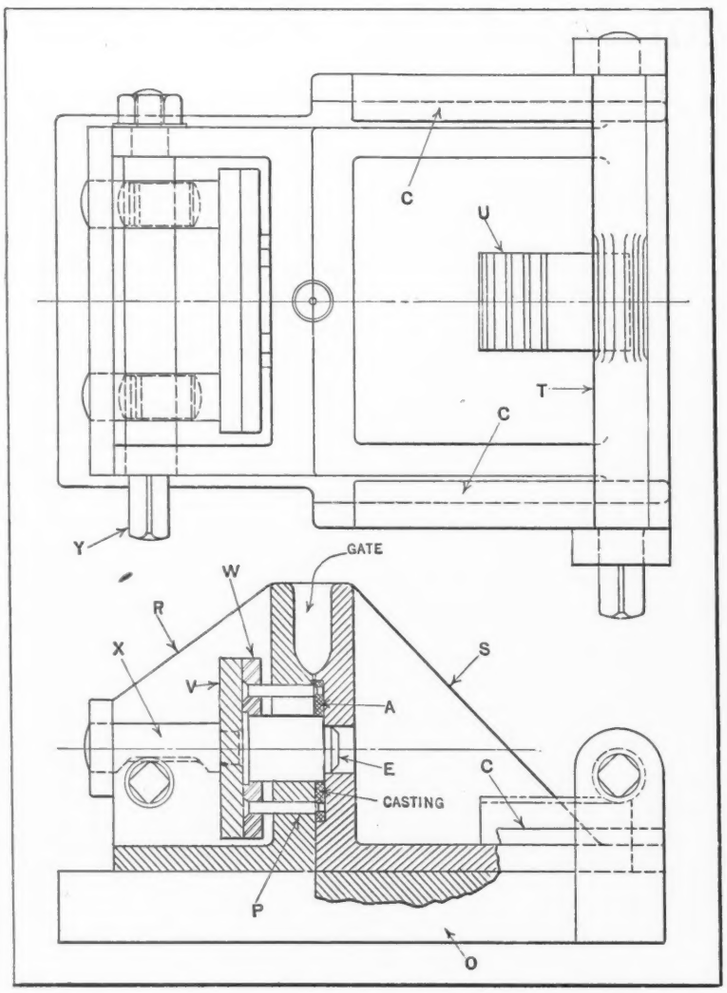


Fig. 2. Permanent Mold for Cover A Shown Assembled on Part B, Fig. 1

The mold shown in Fig. 2, for the cover or ring *A*, has a base *O*, to the left side of which is permanently fastened a ribbed angle-plate *R*. On the right side is a slide *S*, which is held down by gibs *C*. This slide is actuated by the pinion shaft *T* and the rack *U*. The cores are held together on the plates *V* and *W*. The pins *P* slide in the angle-plate *R*, while to the left are two shafts *X* having rack teeth at the bottom, which are operated by the double pinion shaft *Y*. This construction allows the shafts to serve both as guides and racks for the core assembly.

Operation of Molds

In operation, the mold is first heated to about 500 to 550 degrees F. with a blow-torch or any convenient means. The subsequent casting operations, if performed continuously, will keep the mold at the right temperature for producing sound castings. About five to eight seconds after a ladle of hot metal is poured into a mold, the core is withdrawn. This must be done rather quickly, but not too soon. If the core is withdrawn too soon after pouring, the casting might be ruined, while, on the other hand, if it is withdrawn too late, the casting will have become shrunk on so tight that it will be impossible to remove the core. A few seconds after the core has been pulled out, the main slides can be withdrawn and the finished casting removed.

Workmanship Employed on Molds

By the use of these molds, two castings can be produced per minute without much trouble. The workmanship on the molds must be of a good grade, although it does not have to be of the best. Close fitting of the slides would be a waste of time and labor, as when the mold becomes hot, the relationship of the moving parts will change somewhat.

The designer must, of course, provide means for lining up the separate parts of the mold to form an

accurate assembly. In this case, the ring *L* in Fig. 1 and the pilot *E* on the center core of the mold shown in Fig. 2 meet these requirements. The amount of draft on the cores or other members that are required to slide away from the casting must be as great as in the case of sand-mold castings. If necessary, the operator can time himself closely with regard to the withdrawal of the cores, so that the minimum amount of draft or taper may be allowed. The wall thickness (about 5/32 inch) of the castings produced is about the minimum that is practical for the metal used.

Sixty-Three Holes and Slots Punched at One Stroke of the Press

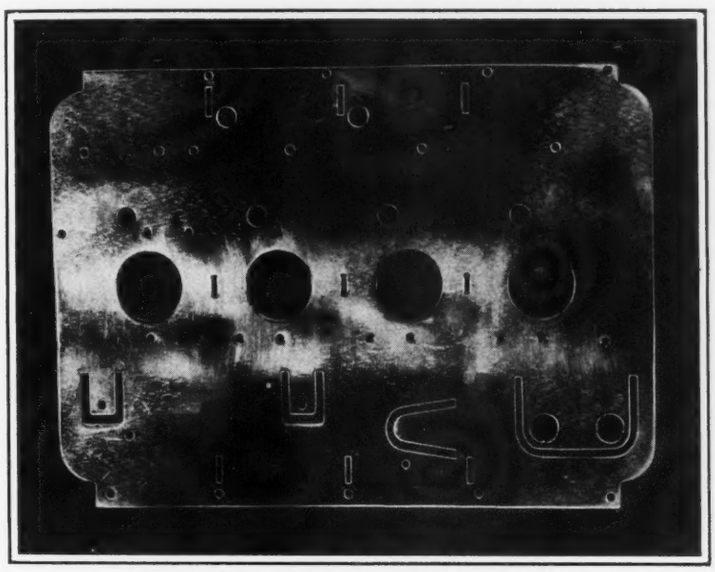


Fig. 1. Cold-rolled Steel Blank in which Sixty-three Holes and Slots are Punched at One Stroke of the Machine

STEEL stampings of the type shown in Fig. 1 are produced at the rate of forty per minute in a die set, the punch of which is shown in Fig. 3. It will be seen that this punch is of the progressive style, all holes and slots being produced at one stroke of the press, and the piece blanked from the sheet in a second stroke. The approximate dimensions of the piece are 7 1/2 by 11 inches, and the material is cold-rolled steel, 0.062 inch in thickness.

The punch, die, and stripper plate were made by the Quality Hardware & Machine Corporation, Chicago, Ill., for use on a 150-ton Henry & Wright press or dieing machine. At each stroke of the machine, the punch unit cuts thirty-eight 1/8-inch holes, six 11/32-inch holes, two 15/32-inch holes, four 1 3/16-inch holes, nine 1/8- by 1/2-inch slots, and four U-shaped slots in the sheet stock, and blanks a piece in which the holes have previously been punched.

One of the important requirements in making this die set was to position all the punches so accurately that when the blank is later bent to the shape illustrated in Fig. 2, the various holes will be the required distance apart within plus or minus 0.0015 inch. Fig. 2 shows how the U-shaped slots cut in the piece facilitate the forming of lugs or shelves.

Attention is called to the construction of the punches that produce these slots. They are mounted on blocks that are integral with the punch-plate instead of being inserted, as is the standard practice. This is done to facilitate locating and assembling. These blocks also contain the round punches for producing the holes in the legs of the U-shaped slots. All the punches were made from Cyclops Wando oil-hardening tool steel.

The punch-plate is made in five sections, so that groups of punches can be removed together. The blanking punch is one solid piece. All the sections are inserted in the punch-holder in order to obtain maximum rigidity of the unit.

The punch-holder was made 3 inches thick, so that it would be sufficiently heavy to absorb all vibration when the punches strike the stock. For the same reason, the die-shoe was made 4 3/4 inches thick. The stripper plate is 3/4 inch in

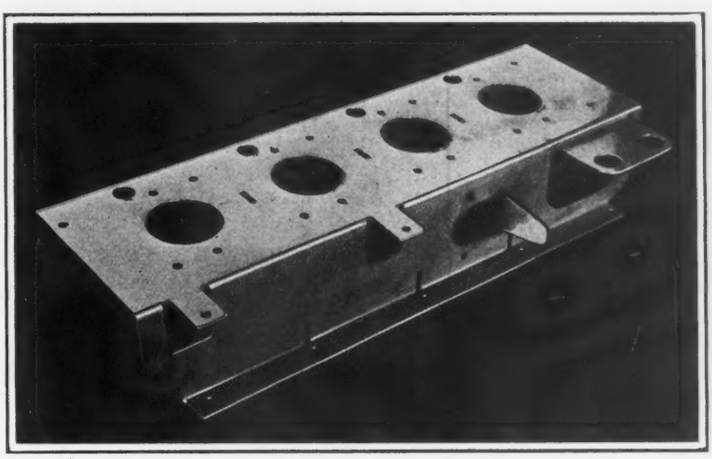


Fig. 2. Part for Radio Receiving Set which is Produced in Two Bending Operations from the Blank Shown in Fig. 1

thickness and is attached to the face of the die. The weight of the punching unit illustrated is about 850 pounds. Approximately 520 hours were required to make the punch, the stripper plate, and the die.

* * *

Making the Pencil Tracing a Permanent Record

By H. H. ESCHLIMAN, Chief Draftsman, Central Alloy Steel Corporation, Massillon, Ohio

Many drafting-rooms make pencil tracings on vellum or tracing paper almost exclusively. The extent to which this material is used is generally dependent upon the amount of handling the tracings are to receive. For a number of years, in the drafting-room where the writer is employed, it was customary to make "rush" drawings in this manner. During this time the files accumulated a considerable number of these tracings, some of which were so soiled that it was impossible to make a legible blueprint from them. Many were so badly torn that ink tracings were made in order to preserve them as records.

A tracing cloth having a surface specially suited for pencil work proved to be a solution to this problem. This cloth was found so satisfactory that it was adopted for making all permanent drawings with the exception of those in which a great many lines were to be drawn. These were inked in because of the difficulty of drawing fine lines with a soft pencil. A tracing made on this cloth produces a print that is clear and legible.

The finished pencil cloth tracings are divided into two groups. One group is composed of tracings used infrequently for reference. After completion, their surfaces are coated with a varnish, which is easily applied with a large paint brush and dries readily. This forms a transparent coating which prevents the lines from being smeared or rubbed off by contact with other tracings, and the surface is so smooth that dust does not adhere readily to it. After a period of more than a year, tracings so treated were found to be in good condition; and the indications are that they will last as long as the best ink tracings.

The second group includes all drawings that are used frequently and are likely to be altered. Photographic reproductions are made of all tracings in this group. A pencil tracing made with reasonable care can be photographed and the print ordinarily will require very little touching up with a pen. After being photographed, the pencil tracing is destroyed. Incidentally, suitable reproductions have also been obtained from Van Dyke prints.

The question naturally arises as to why a tracing so soon to be destroyed should not be made on comparatively low priced tracing paper or vellum. The reason is that it is quicker to make pencil drawings on this cloth than on paper; and as the difference between the cost of the two materials is small in proportion to a draftsman's wages, the use of the cloth is justified. Moreover, a tracing on the cloth makes a better photograph than one made on paper. Consequently the use of the cloth results in a great saving in the time taken to touch up faint lines on the reproduction.

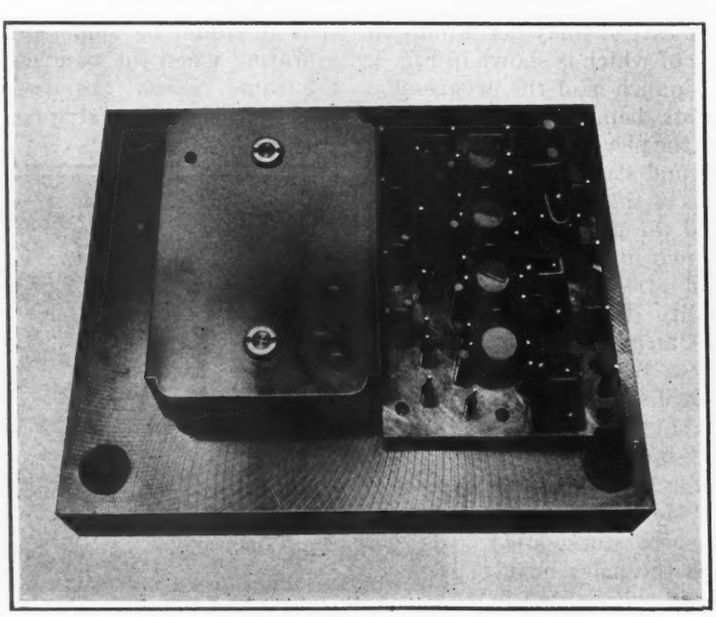


Fig. 3. Punching Unit that Produces All the Holes and Slots at One Stroke and Blanks the Piece in a Second Stroke

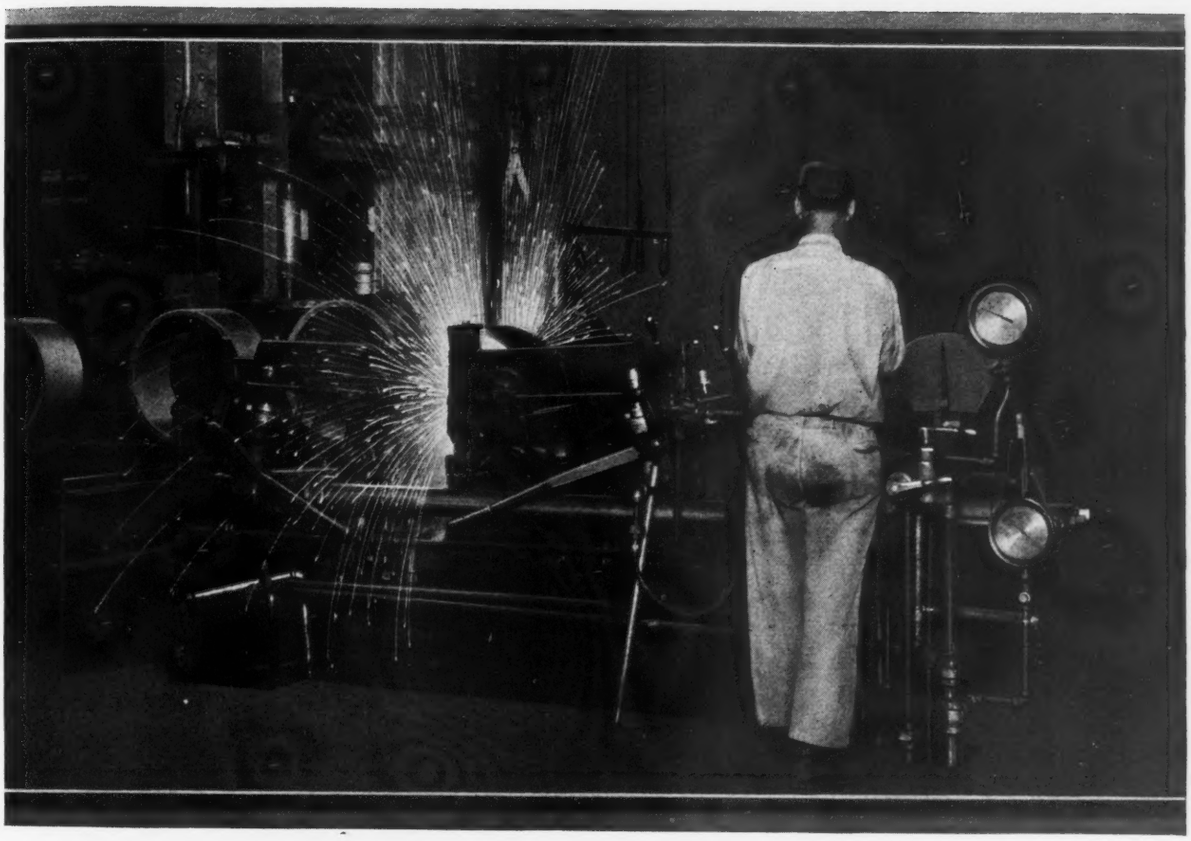
* * *

Coming Meeting of American Society for Steel Treating

The annual meeting of the American Society for Steel Treating, to be held in conjunction with the National Metal Congress and Exposition in Boston, Mass., September 21 to 25, promises to be of outstanding interest from a technical point of view. Not less than sixty-five papers will be presented at the convention covering practically every phase of the metallurgy of both ferrous and non-ferrous metals. Special sessions dealing with the melting of metals, nitriding, and sheet steel are included on the program. The metallurgy of cast iron will also be given special attention. The forenoon sessions will be held at the Statler Hotel in Boston, while the exposition will be arranged on the Commonwealth Pier, where the afternoon sessions will also be held.

* * *

The General Electric Co. had 1287 pensioners on its pension list at the end of 1930. During the year a total of $903,905 was paid in pensions to former employes of the company. The average age of those receiving pensions was sixty-nine years, and the average pension paid during that period was $68 per month.



Butt-Welding Joints Having a Cross-Section of Eighteen Square Inches*

Forcing the Heated Faces of the Joint Together Under a Suddenly Applied Hydraulic Pressure of 100,000 Pounds Insures a Homogeneous Weld

By MALCOLM THOMSON
Thomson Research Laboratory
General Electric Co., West Lynn, Mass.

SEVERAL interesting operations are involved in the manufacture of motor frames. Chief among these is the welding of the ends of the rings used in these frames. These rings are made in several diameters and have various cross-sectional areas up to 18 square inches. The material from which they are constructed is low-carbon steel, made up into rectangular slabs which are cut to the required lengths at the rolling mill, allowance being made for metal displacement during subsequent operations.

In Fig. 1 is shown clearly the sequence of operations. At *A* is indicated a slab as it is received from the rolling mill, and at *B* the slab is shown with both ends formed to approximately the same curvature as the finished ring. In the succeeding operation the slab is rolled to the circular shape indicated at *C*. Following the rolling operation, the ends of the ring are butt-welded, as illustrated at *D*, after which the projecting portion of the weld is removed and the ring is finally sized, thus producing the completed ring shown at *E*.

Forming the Ring to be Welded

In the machine illustrated in Fig. 2, the slab passes between revolving rolls, which form it to a circular shape. During this operation, the ends of the slab are kept in accurate alignment by a stationary vertical plate, against which one edge of the ring bears as it is being formed. This machine has a separate motor drive for raising and lowering the rolls and another motor for rotating them. The lower part of the right-hand housing can be swung downward to allow rapid removal of the ring after it is formed. Incidentally, forming the ends of the slab as shown at *B*, Fig. 1, besides serving the purpose mentioned, also facilitates the entrance of the slab between the rolls.

The abutting ends of the rings are now welded together in the electric welding machine shown in

*Abstract of a paper presented before the American Institute of Electrical Engineers.

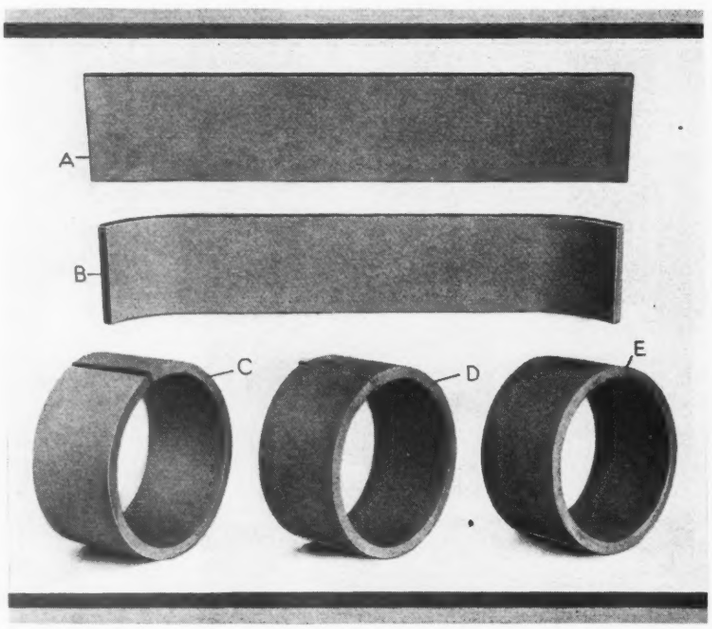


Fig. 1. Successive Stages in the Manufacture of Rings for Motor Frames

the heading illustration. Here the machine is shown in action. A ring is held between the jaws and supported against special aluminum dieblocks by powerful clamps which are actuated by hydraulic cylinders. The operator opens the jaws, in order to separate the ends of the ring slightly, and then slowly feeds the jaws toward each other by means of a hand-valve which controls the jaws hydraulically. In the meantime, a push-button is depressed to turn on the current, and as the ends of the ring approach each other a feeble and then a violent flashing take place. This action continues until a predetermined amount of metal, usually about one inch, has been flashed off. During the flashing, the abutting faces of the ring are raised to the melting point of steel, while the metal immediately adjacent to these faces is subjected to a welding heat mainly by means of heat conducted from the two abutting work surfaces.

At the end of the flashing period the full pressure of the hydraulic ram, or about 100,000 pounds, is applied suddenly, forcing the molten faces together. The result is a perfect and homogeneous weld, all burned or oxidized metal being forced out of the joint. Although this welder is rated as having a capacity for welding cross-sections of 12 square inches, it has been used successfully for butt-welding sections up to 18 square inches. It has a 750 KVA water-cooled transformer, and the open circuit voltage at the welding jaws is 12 volts. The transformer is of special construction to provide the large amount of current required.

After the welding operation, the ring is removed from the machine by an electric hoist and the metal projecting from the weld is removed in a motor-driven broaching machine. The rings are then conveyed to an electric furnace, where they are heated to a temperature of 1400 degrees F. for succeeding operations. This heating process also relieves the internal stresses.

After being removed from the furnace, the rings are passed down on a slide to the eight-cylinder press shown in Fig. 3. This press is below the level of the floor, and in the illustration, part of the flooring has been removed to show the construction. Each cylinder has a removable head to suit various sizes of rings. The rings are lowered into the press in a horizontal position by means of an air-operated table, and there they are squeezed radially to within 3/32 inch of the correct diameter, this variation depending upon the size of the ring.

In conclusion, it might be added that, by the use of electric welding methods, the cost of the completed frames in which the rings are assembled is 25 to 50 per cent less than corresponding steel castings. In addition, the advantage of greater uniformity in dimensions, as well as a more efficient construction of the motor frame, is obtained.

Fig. 2. Machine in which Rings are Rolled to a Circular Shape

Testing Material Society Meets

The thirty-fourth annual meeting of the American Society for Testing Materials was held at the Stevens Hotel, Chicago, Ill., June 22 to 26. In connection with the meeting the Society conducted an exhibit of testing apparatus and machines, the exhibition hall of the Stevens Hotel below the main floor lobby being used for this purpose. Many developments in the testing equipment field were displayed by leading firms in the industry, and a number of ingenious devices that had been developed by committees of the Society as well as by various research laboratories were also shown. The exhibit, which was held for the first time this year, was a valuable feature of the meeting.

The technical sessions of the meeting covered practically every field of engineering. Among the sessions of special interest to the machine-building and metal-working industries were the symposium on the effect of temperature on the properties of metals, and the sessions on steel, wrought iron, corrosion and fatigue of metals, metallography of non-ferrous metals, and malleable iron castings. The permanent headquarters of the Society are at 1315 Spruce St., Philadelphia, Pa. C. L. Warwick is secretary-treasurer.

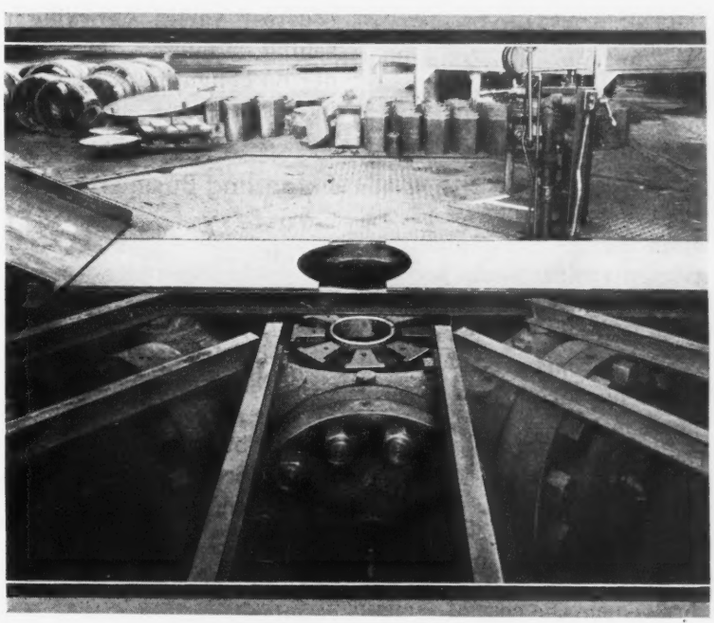


Fig. 3. Eight-cylinder Hydraulic Press for Sizing the Rings. The Press is Located Underneath the Floor and the Rings are Lowered into it by Means of an Air-operated Table

* * *

Selecting Good Welding Steel

As a result of extensive research conducted by Wilmer E. Stine, of the Research Laboratories of the Lincoln Electric Co., Cleveland, Ohio, a graphic formula has been developed for determining the composition of good steel for arc welding. By means of what is known as the Lincoln-Stine equilibrium curve, it is possible to determine, for example, the amount of manganese and silicon that ought to be present in a steel with a given carbon content, in order that the steel shall be especially suitable for use in connection with the arc-welding process. Copies of the chart may be obtained by applying to the Lincoln Electric Co., Cleveland.

Typical Master Plate Design

By EDWARD B. FERNHILLE

Referring to the article "Typical Master Plate Design," on page 665 of May MACHINERY, the writer's opinion is that the method employed introduces a number of inaccuracies.

It is stated in the original article that drills and reamers have a tendency to "crawl." If this is so, then there are fourteen chances of inaccuracy, because all the dowel-holes are drilled and reamed. Moreover, if the faceplate is removed from the lathe to drill these holes, it may be rather difficult to replace it exactly in its former position. Finally, the clamping action on the studs will tend to distort the master plate, with the possibility of throwing the holes out of alignment.

These objections could be easily overcome by eliminating the dowels altogether and using a master plate with holes corresponding and aligned with those in the work. With the work located and clamped in position on this plate, each hole could be lined up concentric with the spindle. This could be done by means of a centering plug having a tapered shank to fit the lathe spindle, the protruding end of this plug entering each hole in the master plate successively.

If a hundred pieces are to be made, it may prove more economical to make a templet jig directly from the master plate for rough-drilling all the holes in the work and then finish the holes as already described.

* * *

Swaging Die for Assembling Collar on Shaft

By EDWARD HELLER

The swaging die shown on page 605 of April MACHINERY seems to have one defect. The member *F* should be backed up by springs and float vertically, so that it will come into contact with the shaft *B* before the die *C* touches the washer *A*. As indicated, the washer will have only partial support during the first part of the operation.

EDITORIAL COMMENT

Every manufacturing company charges against profits, annually, about 10 per cent of the value of its equipment for depreciation. Usually this amount is credited to a reserve account. Unfortunately, the depreciation charge is in most cases merely a book entry. When it becomes necessary to replace old equipment, it is often found that there are no funds available for this purpose. Sooner or later cash will be needed for buying new equipment, but no provision has been made for this.

"We Cannot Afford to Buy Equipment Now"— Why?

In order to insure that funds will be available for replacing old equipment—thus keeping the manufacturing plant in first-class condition to meet competition—would it not be advisable to invest the amount of depreciation charged off annually in liquid securities? Then when replacements become necessary, the cash will be available in this fund. If this were done, the manufacturing executive, faced by the problem of needed replacements, could not be met with the statement, "We cannot afford to buy now." There are companies who actually have created a *replacement fund*, not merely a *depreciation account*. It would be good business for all manufacturers to follow their lead.

The fact that conveyors reduce the cost of transporting materials is not the only reason for using them in machine shops. Sometimes this advantage is incidental, and the actual cost of moving the material does not enter into the problem at all.

Conveyors as Pace Makers in the Production Shop

In many cases, the principal reason for using conveyors is to set the pace at which work ought to be performed by a worker of normal ability. Thus the conveyor singles out the inefficient man and puts the control of the volume of production in the hands of the management rather than in the hands of individual workers. On assembling operations, for example, it is possible to estimate accurately what the daily output will be.

Conveyors also reduce the inventory of both raw material and finished parts, because no material or work in progress is stored around the shop. Neatness and orderliness are direct results of their use. Frequently, there is also an improvement in the quality of the product, because the conveyor system reduces the chances of damage of finished or semi-finished work due to stacking and handling.

All these factors must be taken into account in estimating the value of a conveyor system. The saving in the cost of handling materials should not be the only deciding factor, although frequently this saving is great enough to warrant the installation of a conveyor even if no other advantages were gained.

In most organizations, the conception of business courtesy varies according to whether the firm is selling or buying. Quite often the buyer feels under no obligation to the seller; yet all transactions in business are presumably of mutual advantage. How many firms make it a rule, for example, after having asked for and received bids, to inform the unsuccessful bidders when the deal has been closed? Often, especially in the machinery industries, it is a costly matter to submit bids. In some cases, engineering work worth hundreds of dollars may be involved. It would seem to be a matter of simple business courtesy, after the contract has been placed, to send a letter to all the bidders, stating this fact.

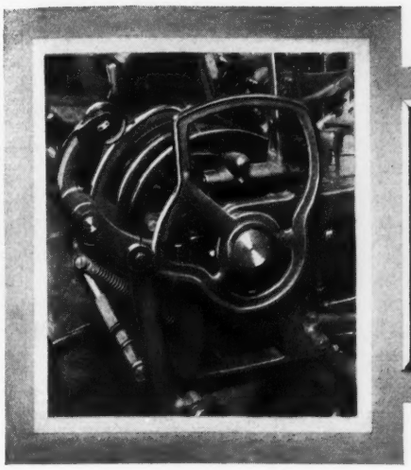
Extending Business Courtesy to the Seller

So much has been said about special versus standard machines that it is doubtful if a single new idea can be brought out that has not been thought of in the past. The advantages of standard machines have been pointed out and the economies of special machines have been emphasized. Men qualified to speak with authority on the subject have championed one type, and others, equally qualified, have favored the other. What is the answer?

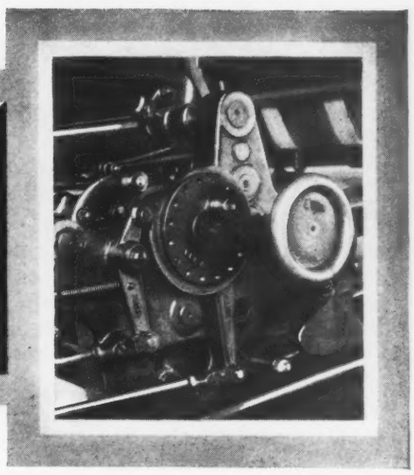
Is It Good Policy to Install Special Machines?

Simply this, that there is a place for both types of machines and that circumstances, manufacturing conditions, and volume of production determine in each case what type should be selected.

At times special machines reduce costs to an almost unbelievable degree — but do not jump at the conclusion that special machines present a universal solution to the cost problem. Those who have bought special machines when standard machines would have met their needs better know that special machines may sometimes increase costs. Every case must be considered on its own merits. Strictly speaking, this is an accounting problem, although an accounting problem with an engineering twist.



Ingenious Mechanical Movements



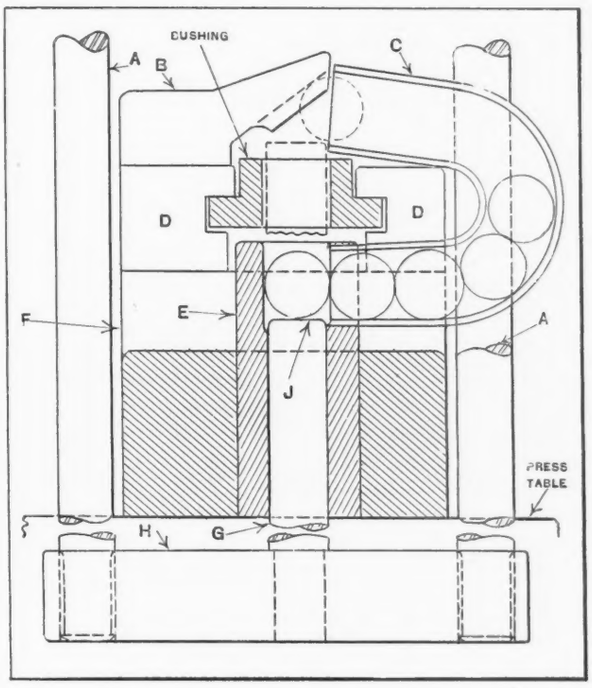
Automatic Burnishing Fixture

By J. E. FENNO

Steel balls are frequently employed for burnishing holes when a very fine finish and an accurate job are required. In most cases, this operation is performed in an ordinary arbor press in which the ball is simply pushed through the work and caught by hand when it falls through. With the design shown in the illustration, however, the work can be burnished automatically in a power press.

The bushings to be burnished are fed into a chute, the end of which is shown at *D*, and carried down by gravity to a position directly over the reciprocating plunger *G*. When the plunger is at its lowest point, one of the balls in the return tube *C* rolls on the end *J*, directly under the hole to be burnished. As the plunger ascends, it pushes the ball up through the work. Continuation of this upward movement carries the ball against the angular surface of the block *B*, and into the return tube *C*, as indicated by the dotted outline of the plunger and ball when at their highest position.

The reciprocating motion of the plunger is derived from the ram of the press through the connecting posts *A* and the plate *H* in which the plunger is a drive fit. A clearance hole in the bolster plate is necessary to allow a through passage of the plate *H*. The bushing *E* is a drive fit in the fixture *F* and a slip fit for the plunger. One side of this bushing has an opening for the lower end of the return tube. This tube may be fastened by straps to the fixture, or it may be soldered to the bushing *E* and to the chute *D*.



Simple Press Fixture for Automatically Burnishing Bushings

Although not shown, the usual provision must be made for tripping the press clutch in case the work becomes jammed in the chute or fails to line up properly with the plunger *G*. One advantage of this fixture is that the wear incident to burnishing is distributed equally among a number of balls.

* * *

Intermittent Motion for High Speeds

By RALPH A. GLEASON

Various forms of intermittent motions have been designed for driving machine parts that must alternately turn through part of a revolution and then dwell or remain stationary between each fractional turning movement. Some mechanisms of this class, however, are not adapted to high speeds owing to excessive shocks each time the driven member is started. The design here illustrated, which is similar in principle to those used on motion picture machines, although much larger, operates quietly and smoothly at high speeds.

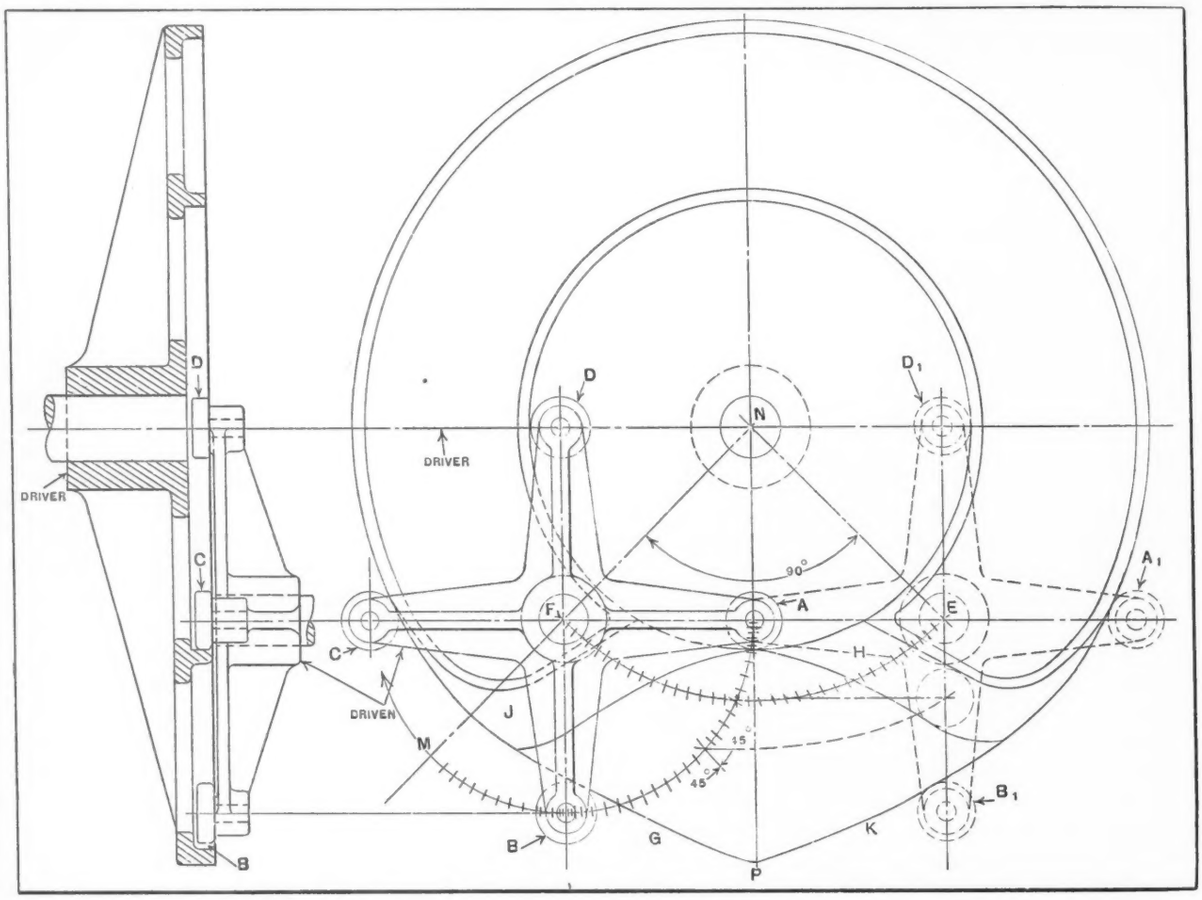
This particular mechanism is used on a milk-bottle cap-making machine. The driver, which is 24 inches in diameter, makes four revolutions to one of the driven member, which has four

equally spaced arms each equipped with a roller, as the illustration shows. The speed of the driver is 960 revolutions per minute, and it requires a minimum movement of 90 degrees to operate the driven member smoothly and quietly at this speed. The action may be extended over a larger angle, thus permitting higher speeds and shortening the idle time.

The rollers on the driven member engage a large annular track (see end view), and after each quarter turn, the driven shaft is securely locked during the idle period. As the driver turns in the direction of the arrow, it rotates the driven shaft intermittently in the same direction. The surface at *G* of the outer track acts against roller *B* until roller *A* enters the groove *H*. When roller *A* has fully entered groove *H*, roller *C* begins to enter groove *J*. When point *P* on the driver passes roller *B*, roller *A* is about half way through groove *H*, and as roller *B* begins to engage surface *K*, roller *A* emerges from track *H*.

When roller *A* has reached the position marked A_1, roller *D* has swung around so that it is again in contact with the inner track as at D_1, roller *B* is at B_1, and the driven member has turned one-fourth of a revolution. The entrance to groove *H* now passes roller *C*, which follows roller D_1 around the inner track. At no time is the driven member free to turn in either direction, except as it is revolved by the tracks or cam grooves, and two or more rollers are always in engagement with the driver.

In order to avoid shocks, especially at high speeds, it is necessary to gradually accelerate and then gradually retard the movement of the driven member. The method of developing or laying out the cam curves to obtain this result will now be explained. With *N* as a center, draw an arc *FE* through the axis of the driven shaft and divide this arc into thirty-six equal spaces. Next, with *F* as a center, draw an arc through the axes of rollers *A* and *B* and extend this arc 45 degrees to point *M*.



High-speed Intermittent Motion with Dwell of 270 Degrees or Less

Beginning at the center of roller *A*, lay off a division of 1 degree, then a division of 2 degrees, followed by one of 3 degrees, 4 degrees, and so on, up to and including 9 degrees. The total number of degrees thus laid off equals 45, since the nine divisions progressively increase from 1 degree up to 9 degrees by increments of 1 degree.

This procedure is now reversed; that is, the divisions begin at the 45-degree point and progressively decrease from 9 degrees down to 1 degree. Beginning at the center of roller *B*, the order is again reversed, the divisions beginning with 1 degree and increasing up to 9 degrees, ending at *M*.

Each division from *A* to *M* is now bisected; consequently, between the centers of rollers *A* and *B*

there are now thirty-six divisions, the same as between the centers *F* and *E*. Assume that the divisions from *F* to *E* are numbered from 1 to 36, and that the divisions from *A* to *B* are also numbered from 1 to 36.

From these divisions we shall now proceed to locate various points on the center lines of the cam grooves *J* and *H*. With *N* as a center, draw an arc through division number 1 on arc *AB*, extending it to the right and left of the vertical center line *NP* a short distance. Draw another arc through division number 2 and continue up to division number 36 next to the center of roller *B*. The arcs through these various division points need not be continuous, but they should be located to the right and left of the vertical line *NP* far enough, as near as can be judged, to intersect the center line of the cam grooves.

Now set the compass to the radius of the driven member, or from the center of shaft *F* to the center of one of the rollers. With division number 1 (adjacent to *F*) as a center, draw an arc intersecting arc number 1 struck from center *N* and to the *right* of the vertical line *NP*. Continue until arcs of the radius of the driven member have been struck from each of the thirty-six divisions on *FE*, thus intersecting all of the thirty-six arcs (to the right of *NP*) struck from center *N*.

The thirty-six centers thus located lie on the center line of the cam groove *H*, and various points along the sides of this groove are located by setting a bow pencil or bow pen to the radius of the driven rollers and drawing a series of arcs. The sides of groove *H*, which are tangent to these arcs, can then be drawn.

To lay out the cam groove *J*, again use the compass set to the radius of the driven member, and in striking arcs to intersect those extended to the left of *NP* from *N*, work from *E* to *F;* for example, with division number 36 as a center (adjacent to *E*) intersect arc number 1 struck from center *N* and to the *left* of the line *NP;* continue until finally division number 1 (adjacent to *F*) is used in striking an arc intersecting arc number 36 struck from *N*. In this way, the series of roller centers for groove *J* can be located.

In laying out the curve *GPK* of the outer track of the driver, proceed as follows: With *N* as a center, and from each of the eighteen divisions on the arc from the center of *B* to *M*, strike eighteen arcs to the right of center *P* and eighteen to the left, all adjacent to the surfaces *K* and *G;* then with the compass set to the radius of the driven member, intersect the thirty-six arcs just struck by another series of thirty-six arcs from the divisions on arc *FE*.

If we assume that the thirty-six arcs adjacent to *G* and *K* are numbered from 1 to 36 from left to right, then division number 1 on *FE* will be used to intersect arc number 1, and so on, until the thirty-sixth division, adjacent to *E*, is used to intersect the thirty-sixth arc at the extreme right of surface *K*. Arcs equal to the roller radius are now struck from these thirty-six centers to locate points along the profile *GPK*.

Although the ratio of this particular mechanism is 4 to 1, other ratios are possible by adding more arms and rollers to the driven member and extending the cam action over a longer arc on the driver. This mechanism has one objectionable feature—the driven shaft must end at the driver and cannot be supported on each side, as will be evident by examining the end view. However, the continuous positive relation between the driving and driven members, the good distribution of wearing surfaces, and the adaptability to high speeds with smooth action compensate for the objectionable feature mentioned.

Maintaining Confidence

In times of depression there is always uncertainty in the minds of employes regarding the permanency of their employment. This is regrettable in many respects, one unfortunate result being that the already reduced purchasing power of the working population is still further curtailed by the fear of loss of employment when such fear may be unwarranted. Several large industrial concerns, therefore, have made it a practice to inform their workers for as long periods ahead as possible that their employment is secure; and when lay-offs become necessary, they give as long advance notice as is feasible. If all employers would follow this practice, the anxiety and difficulties due to fear of unemployment would be greatly alleviated, and confidence would be restored among a large number of workers who now are uncertain as to future developments.

* * *

The toll exacted by corrosion is very great in many industries, especially in those where acids and other chemicals affecting metals are used. The metal tantalum can be employed in many instances to prevent the effects of corrosion. A process for refining this metal has been developed on a commercial scale by Dr. C. W. Balke of the research staff of the Fansteel Products Co., Inc., North Chicago, Ill. Corrosion tests have shown that tantalum is unaffected by practically all acids, alkalis, and gases—organic or inorganic—at ordinary temperatures or state of concentration. Only hydrofluoric acid or hot concentrated caustic will attack the metal. The only apparent limitations of tantalum are that it cannot be cast and should not be used at temperatures exceeding 400 degrees C. (approximately 750 degrees F.).

* * *

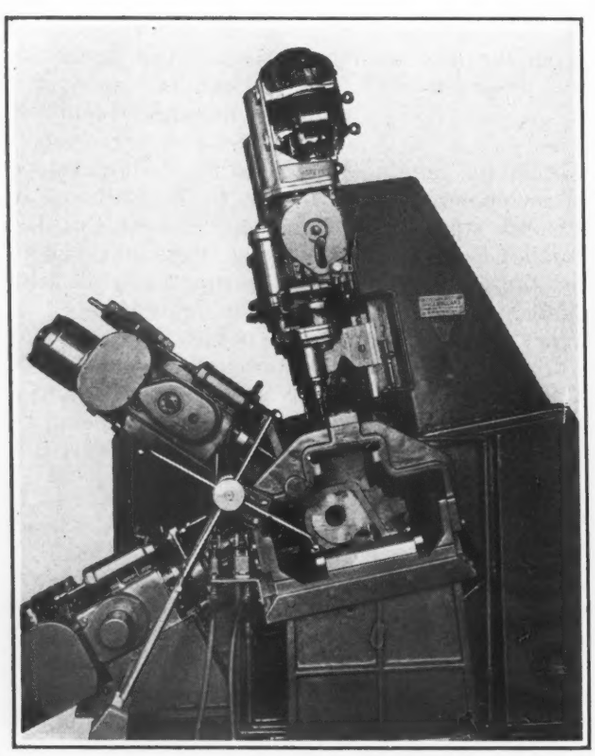
Seamless tubing is now being made from stainless steel. This tubing is used largely in the chemical industries for conveying fluids and gases that would attack ordinary kinds of steel tubing, but would have little or no effect on the corrosion-resisting stainless steel. This is another of the many applications of stainless steel.

Building Special Machinery on the Unit Plan

The Gradually Growing Practice of Designing Special Machinery so that it Can Be Assembled from Unit Mechanisms Greatly Reduces Costs

THE practice of building standard machine tools by designing the unit mechanisms so that they could be built independently and assembled in the machine as required was quite well established twenty-five years ago; and headstocks, gear-boxes, feed mechanisms, and other individual units of machine tools have been constructed as unit mechanisms for many years. It is only recently, however, that this principle of construction has been applied to special machine shop equipment intended for performing machining operations on a single part in production work.

Fig. 1. Machine Having Four Standard Units for Drilling and Tapping Cylinder Blocks



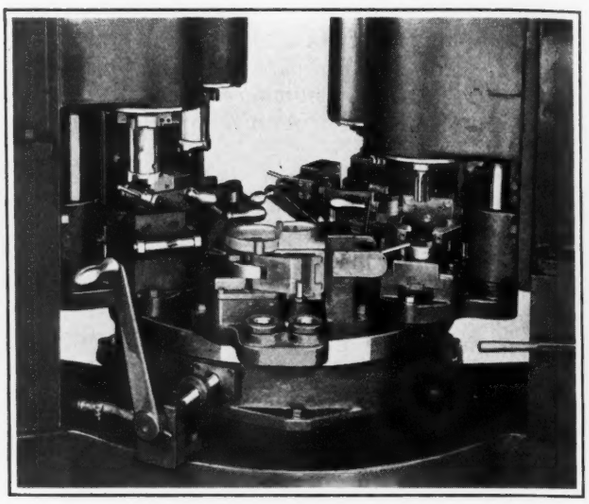


Fig. 2. Close-up View of Machine Having Four Boring-quill Units Applied to a Magneto Frame

An interesting example of this method of building special machinery by assembling the required unit mechanisms in accordance with the needs of an individual manufacturing problem is furnished by the Millholland Sales & Engineering Co., Indianapolis, Ind. This company has standardized a number of designs of drilling, boring, tapping, and milling heads; beds; bases; machine legs; chip pans; lubricant tanks with pump brackets; and motor brackets for the recently standardized machine tool motors.

In fact, the company not only uses these units in its own shop for building special machines to meet the needs of individual customers, but will also supply them to customers, so that any concern with tool-room facilities can assemble special machines for its own use without the cost and inconvenience of making up a complete design and having patterns and castings made. These units are built in a wide range of sizes. For example, the drilling units are standardized for drilling holes from 1/8 inch to 3 inches in diameter in steel, and are capable of taking end-thrust loads ranging from 3000 to 14,000 pounds in accordance with the size of the unit.

Through the application of the principle outlined, it is possible to produce a machine rapidly that will perform drilling, tapping, and milling operations at one setting. For example, one automobile engine builder drills a long hole in the cylinder block and mills a recessed pad on one side of the block at the same setting. The result of the installation of this machine was that the cylinder line was shortened about 10 feet, $5000 was saved in machine investment, and one additional handling of the cylinder block was eliminated.

The most suitable mounting for the motors in unit heads, designed along the lines indicated, is the flanged type. In applying this type of mounting, many new problems had to be solved. The mounting

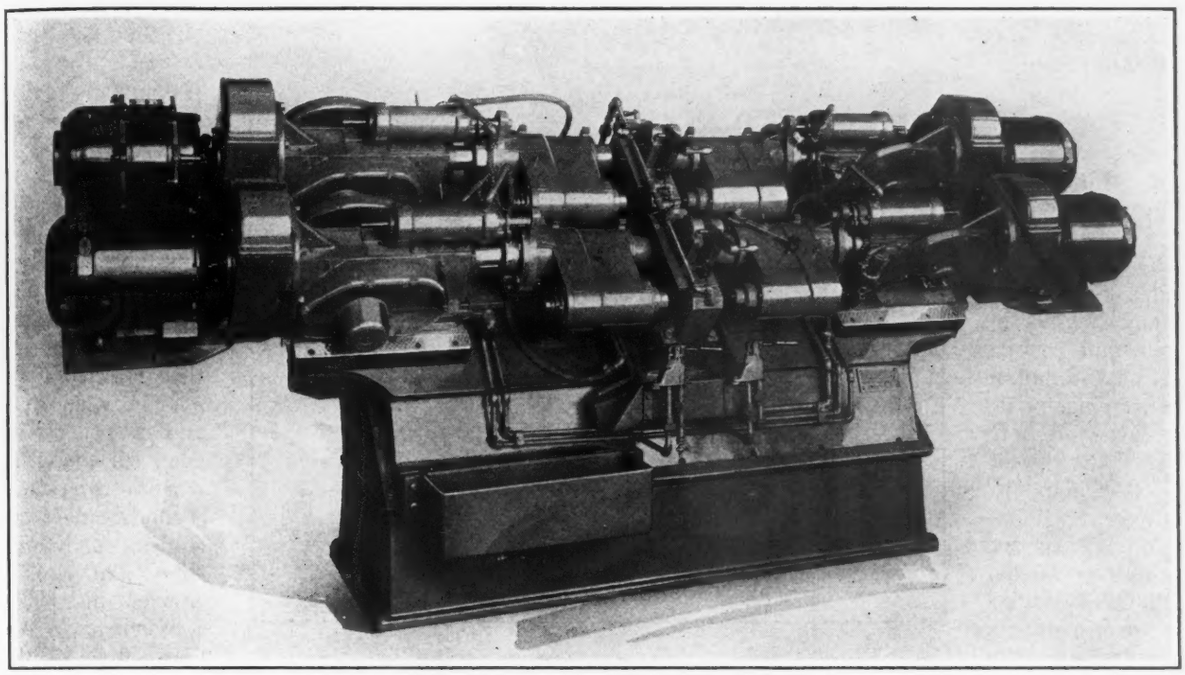


Fig. 3. A Duplex Facing Machine for Automobile Connecting-rods Built up from Four Standard Units

had to be suitable for heads placed in a horizontal, vertical, inverted, or inclined position. Provision had to be made for running the motor pinion and driven gear in grease with a suitable oil-tight seal. A simple method was required to compensate for the variation in distance between the plane of the motor feet and the center of the armature shaft. Furthermore, a compact design, requiring a minimum space, and a strong yet artistic mounting were features to be desired. How this problem was met is indicated in a number of the accompanying illustrations, more especially in Figs. 3 and 4.

The motors are mounted on an L-shaped bracket. The pinion housing at the machine end is an oil-tight compartment into which the motor shaft extension projects. This type of mounting has proved to be unusually free from vibration and to provide for quiet running conditions. The mountings are standardized to fit the new standard motors of the National Electric Manufacturers' Association.

The accompanying illustrations show a number of machines built from unit parts. They also show a few of the units ready to be assembled to the machine beds or frames.

Fig. 1 shows a machine provided with four standard units for drilling and tapping cylinder blocks. Three 1/2-inch holes are tapped at an angle, and eight 5/16-inch holes are drilled in the top of the cylinder block. The production is two blocks per minute, floor-to-floor time. A feature of special interest is the remote-control feed-starting valve located in the lower left-hand corner of the machine.

Fig. 4. A Machine Assembled from Six Units for Performing Drilling Operations on Cylinder Blocks

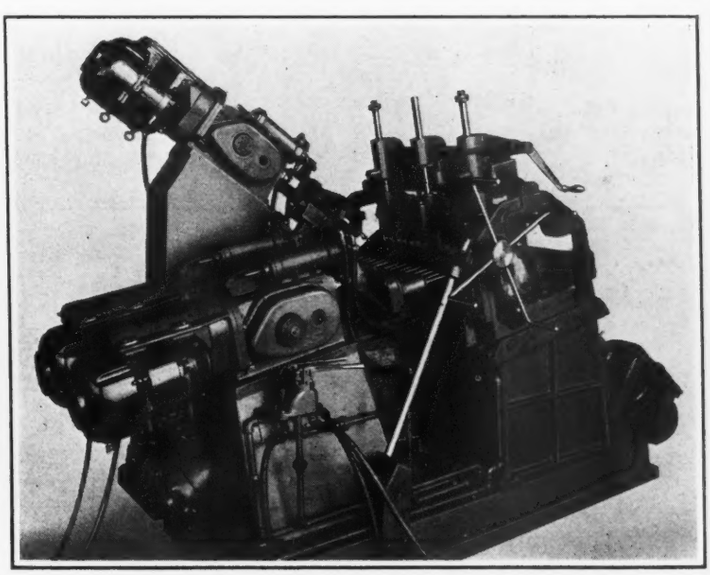


Fig. 2 shows ball-bearing rotating-sleeve boring-quill units at work on a magneto frame. The nature of the work prevents piloting the tool, but the con-

struction of the heads is such as to maintain accurate center distances and alignment. Four heads are used, the fixture being indexed by hand.

Fig. 3 shows a duplex facing machine in which the upper and lower ends of automobile connecting-rods are faced on both sides at the rate of 600 per hour by one operator. The upper half of the machine is loaded while the lower half performs its operations. The heads are placed on an angular bed to facilitate the operator's work and also to provide a convenient way of getting rid of the chips. The chip problem is often a very serious one in high-production machines. It is solved in a very satisfactory way in this machine.

Fig. 4 shows a machine for performing additional operations on the same cylinder block as shown in Fig. 1. This machine is provided with six standard units. Note the application of the motor mounting bracket. No change in the mounting principle is required in any position. Spacer blocks compensate for variations in motor dimensions measured from the feet to the shaft center line.

This machine is used for drilling six 9/32-inch holes, 3 inches deep, in the main bearings of the cylinder blocks. This drilling is done from below with two units. Sixteen 1/8-inch oil-holes for valve tappets are drilled with two units. One unit also drills and spot-faces an oil-hole with a U-size drill and a 7/8-inch spot-facing tool. The unit mounted underneath the others at the front on an angle also drills and spot-faces. The cycle for the entire work is thirty-nine seconds, not including the loading time. The work is carried on roller conveyors, so that the floor-to-floor time is about one minute.

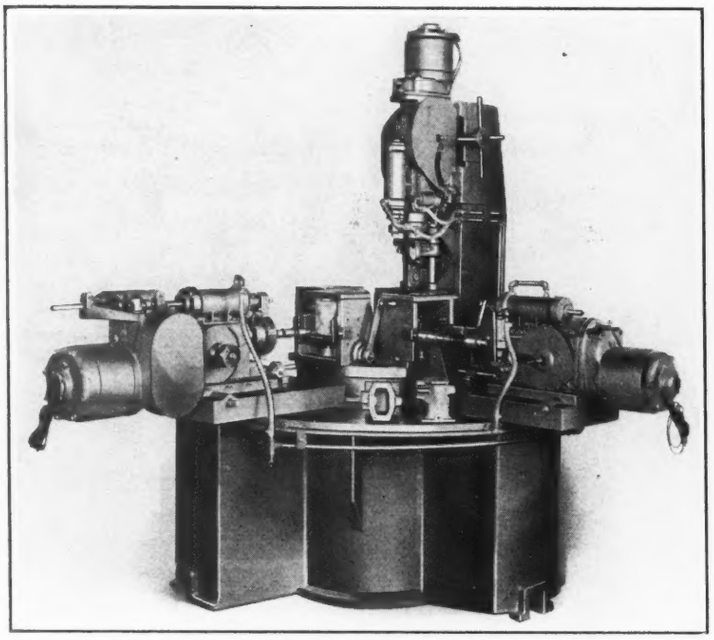


Fig. 5. A Combination Milling, Drilling, and Tapping Machine with Units Held on a Standardized Base

Fig. 5 shows a combination milling, drilling and tapping machine with a hand-indexing fixture; this example illustrates the variety of combinations that are possible with different types of beds and column supports.

Figs. 6, 7, 8, and 9 show individual units of different design. Fig. 6 is a milling unit. The cutter can be operated either right- or left-hand or may be arranged to approach the work either from the top or from the bottom. This particular unit was mounted on a deep-hole drilling machine for a cylinder block operation, milling off the gasoline pump pad (which is 3 inches in diameter) in twenty-four seconds. Fig. 7 shows the largest drilling unit built in this series, having a 7 1/2-horsepower motor. The design, however, is such that a 15-horsepower motor may be applied if required. This unit has

Fig. 6. A Milling Unit that can be Attached to a Machine Base or Column

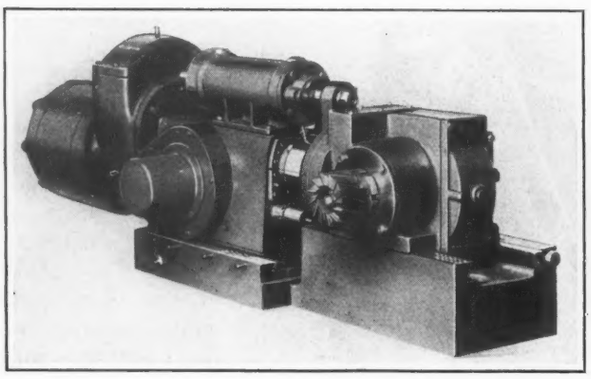
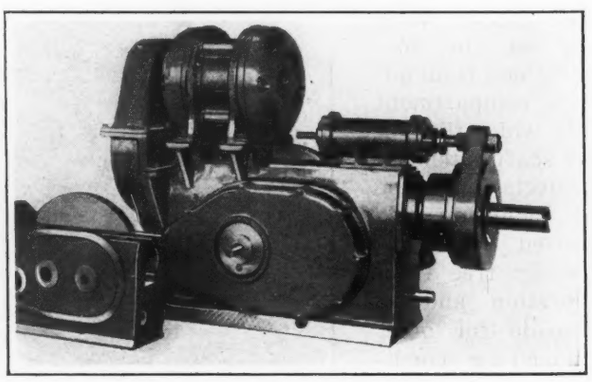


Fig. 7. The Largest Drilling Unit Built, Having a Spindle Stroke of Eight Inches



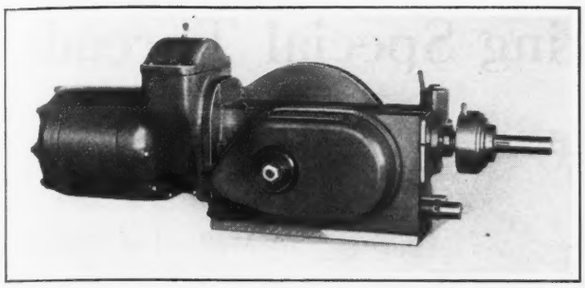


Fig. 8. A Drilling Unit of One of the Smaller Sizes, Requiring a Maximum of 3 Horsepower

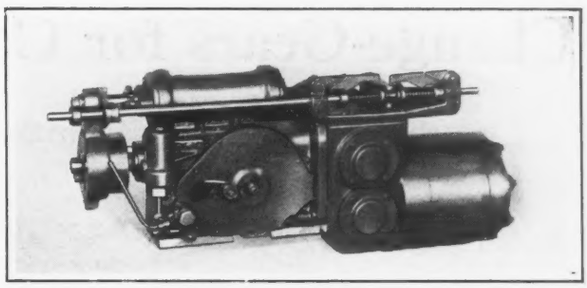


Fig. 9. A Tapping Unit Provided with a Flanged Quill for Attaching a Multiple-spindle Head

an 8-inch spindle stroke. Fig. 8 shows a drilling unit having a maximum stroke of 5 1/2 inches, requiring a maximum of 3 horsepower. Fig. 9 shows an example of a tapping unit with a flanged quill for a multiple-spindle head. It also has a pneumatic counterbalance and a remote-control air starter.

The examples shown illustrate but a few of the almost unlimited number of combinations that can be obtained through the application of a comparatively small number of standard units. The general idea of this method of design, however, is well illustrated by these examples.

Determining the Shearing Pressure of a Die and the Safe Load for a Power Press

By C. W. HINMAN

In designing blanking dies, the question frequently arises whether the capacity of the press is such as to withstand the pressure due to the blanking operation. By the use of the constants given in the accompanying table, which was compiled by the writer, the blanking pressures required for various materials may be found. These constants, obtained from punch press formulas, were checked by means of a shear testing machine in the plant where the writer is employed, and have been in successful use for several years.

The actual pressure, in tons, required for blanking any of the materials listed can be determined by multiplying the perimeter of the blank, in inches, by its thickness and multiplying this result by the constant given. Assume, for example, that a blank of half-hard brass has a perimeter of 21 inches and is 0.081 inch thick. Then the pressure required to blank this piece will be $21 \times 0.081 \times 13 = 22\ 1/8$ tons, nearly.

If the actual capacity, in tons, of a power press is not known, it can be determined easily by squaring the diameter of the main crankshaft bearings and multiplying the result by 3 1/2. Thus, if the diameter of the shaft is 4 inches, the actual capacity of the press will be $4 \times 4 \times 3\ 1/2 = 56$ tons.

By these simple methods of obtaining the press capacity and the blanking pressure, a press can be chosen in which the die may be operated without danger of overloading.

Constants for Obtaining Blanking or Shearing Pressures for Various Materials (Constants to be 20 Per Cent Less for Punches Having Shear)

Material	Constant	Material	Constant
Aluminum Castings	6.0	Paper (Using Flat-end Punch)	3.2
Aluminum Sheets	10.0	Rawhide	6.5
Brass Castings	18.0	Steel (Boiler Plate and Angle Iron)	30.0
Brass Sheets (Half Hard)	13.0	Steel (Cold-drawn Rod)	29.0
Bristol Board (Using Dinking Die)	1.5	Steel (Drill Rod—Not Tempered)	40.0
Bristol Board (Using Flat-end Punch)	2.5	Steel (Half Hard)	30.0
Copper Castings	15.0	Steel (Mild C.R. Sheets)	25.0
Copper (Rolled)	12.0	Steel (Nickel—3 to 5 Per Cent)	40.0
Fiber (Hard)	11.0	Steel (Spring—1.00 Carbon)	42.0
German Silver (Half-hard Sheets)	16.0	Steel (Spring—1.20 Carbon—Not Tempered)	45.0
Iron (Cast)	10.0	Steel (Sheet—Tin Coated)	25.0
Iron (Wrought)	25.0	Steel (Tool—Red Hot)	7 to 10
Lead	1.5	Straw Board (Using Dinking Die)	1.0
Leather (Chrome)	3.5	Straw Board (Using Flat-end Punch)	1.95
Leather (Oak)	3.5	Zinc (Rolled)	9.0
Paper (Using Dinking Die)	1.5		

Change-Gears for Cutting Special Threads

By FELIX E. AVERILL

Calculating Auxiliary Change-Gears for Cutting Pitches Not Within the Range of the Regular Gear-Box

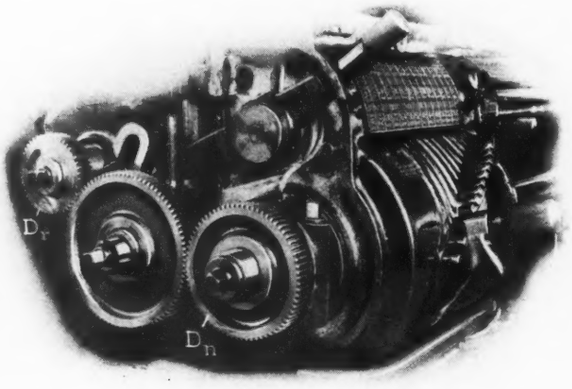


Fig. 1. Auxiliary Change-gears for Quick-change Gear Type of Lathe

A Method of Utilizing Various Settings of the Change-Gear Box to Avoid Using Special Auxiliary Gears

MANY lathes of modern design are provided with quick-change gears. Such lathes cut threads within the range for which they are designed by simply making the settings indicated on the index-plate, and no calculations are required. It often happens, however, that a screw or worm thread of a pitch not indicated on the gear-box must be cut on one of these lathes. To meet this requirement, some change must be made in the gear train from the spindle, which, in conjunction with some setting on the gear-box, will give a lead-screw speed that will cut the pitch of thread desired.

Whenever lathes have auxiliary change-gears, as shown in Fig. 1, the pitch obtained from the gear-box can be varied readily for cutting threads of unusual pitch. The direct method of calculating these auxiliary change-gears, to be described, makes it possible to utilize any of the regular gear-box settings in order to avoid, in most instances, the use of special change-gears for cutting threads that are outside of the ordinary range. For example, if 4/7 thread per inch is to be cut, the gear-box of the lathe referred to later would be set for cutting 2 1/4 threads per inch, thus permitting the regular auxiliary change-gears to be used. Just how the gear-box setting and the change-gear sizes are determined will be shown later by typical examples.

The problem is complicated by the fact that the lead-screw is driven through the gear-box, which has many combinations, the ratios of which, presumably, are unknown. The effective ratios, however, represented by the various gear-box settings can be found by a simple calculation, and it is this fact that forms the basis of the following formulas.

Simple Principle Underlying Change-Gear Calculations

As is generally known, any simple gear ratio, such as 8/27, for example, may be factored to get two pairs of gears (compounding) which will give the same over-all ratio as the simple pair. Thus $8/27 = 2/3 \times 4/9$; and a compound gear train having ratios of 2 to 3 and 4 to 9 would have an over-all ratio of 8 to 27. The process of factoring may be carried out further, as $8/27 = 2/3 \times 2/3 \times 2/3$, showing that a train of three pairs of gears, each with a ratio of 2 to 3, will also give the over-all ratio of 8 to 27 (see Fig. 2).

The factoring of any ratio might be carried out almost indefinitely to obtain any number of component ratios; and, conversely, the over-all ratio of any complex gear train can be found by multiplying together all the component ratios or factors represented by the various pairs of gears.

In a complex gear train, such as that on a lathe having quick-change gears, if the over-all ratio and the ratio of one pair of gears are known, the component ratio may be found. Furthermore, it does not matter whether this component ratio represents one pair or more than one pair of gears.

For example, if 8/27 represents the over-all ratio of the lathe and 2/3 represents the ratio of the accessible gears on the end of the headstock which may be changed, then 4/9 would be the component ratio, representing all other gears in the train from the spindle to the lead-screw, including some unknown ratio or ratios in the gear-box. (See Fig. 3.) These unknown ratios would be represented in our example by the $2/3 \times 2/3$, which, combined, would make the component 4/9. The factoring of the component ratio is not necessary to the solution of our problem, and, therefore, the ratios of the gears in the box may be entirely disregarded.

In practice, the over-all ratio of the lathe for any setting of the gear-box is expressed by the method used in calculating simple gearing; that is, by a ratio expressed as a fraction with the numerator equal to the number of threads per inch on the lead-screw and the denominator equal to the number of threads per inch to be cut. Thus, if the lead-screw has 4 threads per inch and the gears

are set to cut one thread per inch, the over-all ratio of the lathe for that setting is 4/1. In using the following formulas, the over-all ratio is always the number of threads per inch on the lead-screw divided by 1, whether the lathe is designed to cut one thread per inch or not. This gives a unit ratio that is easily handled in the calculations.

Change-Gear Formulas

In any gear train, since the over-all ratio equals the product of its component ratios, if the over-all ratio and one component are known, the other component may be found. This principle will be expressed in the following formulas. (See notation in table "Summary of Change-gear Formulas".)

To begin with, the over-all ratio is considered equivalent to the number of threads per inch on the lead-screw divided by 1; thus,

$$\frac{L}{1} = \frac{D_r}{D_n} \times \frac{n}{d} \qquad (1)$$

Therefore,

$$\frac{n}{d} = \frac{L}{1} \div \frac{D_r}{D_n}$$

Then,

$$\frac{n}{d} = \frac{L}{1} \times \frac{D_n}{D_r} \qquad (2)$$

Formula (2) is for finding the component ratio $\frac{n}{d}$.

Example Showing How Change-Gears are Calculated

Assume that a quick-change gear type of lathe is to be geared for cutting 1 1/4 threads per inch. The regular range of the gear-box is 1 1/2, 1 3/4, 2, 2 1/4, 2 1/2, 2 3/4, 3, 3 1/4, 3 1/2, 4, 4 1/2, etc., threads per inch. The lead-screw has 4 threads per inch, and the change-gears on hand have the following numbers of teeth: 35, 40, 50, 60, 70, 90, 120. As the lathe is now geared, $D_r = 48$ and $D_n = 72$. Can either of these gears be used, and what gear-box setting is required to cut 1 1/4 threads per inch?

Substituting the known values of L, D_r, and D_n in Formula (2) and solving, we find that $\frac{n}{d} = \frac{288}{48}$ or $\frac{6}{1}$ which is the component ratio for the particular lathe in question if set to cut one thread per inch.

For the sake of clearness, we might, at this point, revert to the original formula (1) and substitute the values, all of which are now known, thus getting:

Summary of Change-Gear Formulas

D_r = number of teeth in driving change-gear;
D_n = number of teeth in driven change-gear;
n = numerator of component ratio;
d = denominator of component ratio = threads per inch indicated on one or more gear-box settings;
L = number of threads per inch on lead-screw;
T = number of threads per inch to be cut; and
F = factor for raising over-all ratio to higher terms.

Formulas	Example
$\frac{L}{1} = \frac{D_r}{D_n} \times \frac{n}{d}$ (1)	To cut 1 1/4 threads per inch Lead-screw has 4 threads per inch D_r has 48 teeth; D_n has 72 teeth
$\frac{n}{d} = \frac{L}{1} \times \frac{D_n}{D_r}$ (2)	$\frac{n}{d} = \frac{4}{1} \times \frac{72}{48} = \frac{288}{48} = \frac{6}{1}$
$\frac{L}{T}$ = Over-all ratio of threads to be cut (3)	$\frac{L}{T} = \frac{4}{1\ 1/4} = \frac{4}{5/4} = \frac{16}{5}$ (now $L = 16$)
$F = \frac{D_r \times n}{L}$ (4) F must be a whole number	$F = \frac{48 \times 6}{16} = 18$ If necessary, use new gear for D_r to make F a whole number
$\frac{L \times F}{T \times F} = \frac{D_r}{D_n} \times \frac{n}{d}$ (5)	$\frac{16 \times 18}{5 \times 18} = \frac{288}{90} = \frac{48}{D_n} \times \frac{6}{d}$ and $\frac{288}{90} = \frac{48}{60} \times \frac{6}{1\ 1/2}$ Therefore $D_n = 60$ and $d = 1\ 1/2$

$\frac{288}{72} = \frac{48}{72} \times \frac{6}{1}$; $\frac{288}{72}$ is simply the original ratio of $\frac{4}{1}$ raised to higher terms.

Having now found the component ratio, we may proceed to determine what change should be made in the gears $\left(\text{ratio } \frac{48}{72}\right)$ in order to secure the over-all ratio for cutting 1 1/4 threads per inch.

$$\text{The over-all ratio} = \frac{L}{T} \qquad (3)$$

The over-all ratio for 1 1/4 threads per inch $= \frac{4}{1\ 1/4} = \frac{16}{5}$. From this point in the calculations, L is given the value of 16 instead of 4, as the ratio $\frac{4}{5/4}$ is the same as $\frac{16}{5}$, and the latter is expressed in whole numbers which are easier to use.

How the Gear-Box Setting is Determined

The next and final step is to determine what combination of change-gears and gear-box setting will be equivalent to the over-all ratio of $\frac{16}{5}$ required in this instance. Formula (1) may also be expressed

$$\frac{L}{T} = \frac{D_r}{D_n} \times \frac{n}{d}$$

Hence in this example, the ratio of $\frac{16}{5}$ equals the ratio of $\frac{48}{72} \times \frac{6}{d}$. Let us see now if we can retain the change-gear of 48 teeth and replace the driven gear only, so that $D_n \times d$ balances the equation.

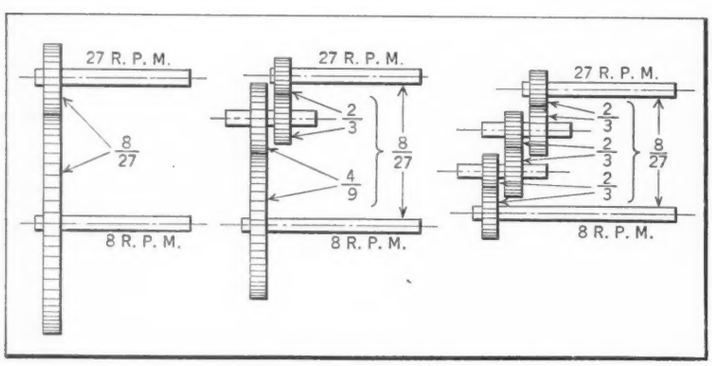


Fig. 2. Diagrams Illustrating Simple Principle Underlying Method of Calculating Change-gears Described in this Article

First, multiply 16 by some factor (F) to raise $\frac{16}{5}$ to higher terms so that the numerator equals 48×6.

$$F = \frac{D_r \times n}{L} = \frac{48 \times 6}{16} = 18 \qquad (4)$$

If F does not equal a whole number, then D_r must be changed, as shown later by another example. Continuing with the calculation, we have:

$$\frac{16 \times 18}{5 \times 18} = \frac{288}{90} = \frac{48}{D_n} \times \frac{6}{d} \qquad (5)$$

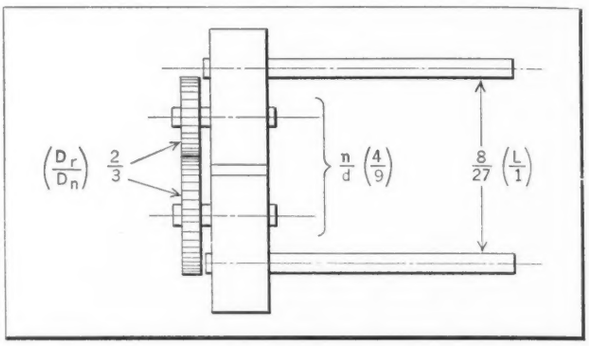


Fig. 3. Diagram of Complex Gear Train with Unknown Factors, Illustrating the Fundamental Formula (1) for Change-gear Calculations

It is evident now that $D_n \times d$ must equal 90. To find the value of D_n, or the number of teeth in the driven gear, merely divide 90 by any value of d that will give a quotient equal to the size of any available change-gear. In this case, $90 \div 1\ 1/2 = 60$ which is the number of teeth in one of the change-gears; also, $90 \div 2\ 1/4 = 40$.

Therefore, the over-all ratio $\frac{288}{90} = \frac{48}{60} \times \frac{6}{1\ 1/2}$ or $\frac{288}{90} = \frac{48}{40} \times \frac{6}{2\ 1/4}$. In this example, then, if the driven gear has 60 teeth, the gear-box would be set for 1 1/2 threads per inch; but a driven gear of 40 teeth could be used provided the gear-box were set for 2 1/4 threads per inch. The example just given illustrates how the gear-box setting might be varied in order to enable one of the regular change-gears to be used.

Another Example of Change-Gear Calculation for Special Thread Cutting

In order to illustrate the procedure when both driving and driven change-gears must be selected, assume that a worm is to be threaded and the pitch is 1 3/4 inches. The conditions otherwise are to be the same as in the previous example, L being equal to 4 and the stock of change-gears to be the same as listed for the first example.

The pitch of the thread is first changed to obtain the equivalent threads per inch:

Threads per inch $= 1 \div 1\ 3/4 = 4/7$.

The over-all ratio

$$\frac{L}{T} = \frac{4}{4/7} = \frac{28}{4}$$

Hence L now is considered equal to 28.

If the lathe could be geared for one thread per inch, the component ratio would be;

$$\frac{n}{d} = \frac{72}{48} \times \frac{4}{1} = \frac{6}{1}$$

and

$$\frac{28}{4} = \frac{D_r}{D_n} \times \frac{6}{d}$$

Determine now whether D_r can equal 48 as before, or whether both D_r and D_n must be changed. If $D_r = 48$, then:

$$F = \frac{D_r \times n}{L} = \frac{48 \times 6}{28} = \frac{72}{7}$$

As F in this case is not a whole number, insert other values for D_r (equivalent to gears on hand) until, by trial, a whole number F is obtained. For example, if $D_r = 70$, then

$$F = \frac{70 \times 6}{28} = 15$$

Raising the over-all ratio to higher terms

$$\frac{28 \times 15}{4 \times 15} = \frac{420}{60} = \frac{70}{D_n} \times \frac{6}{d}$$

One of the settings of the change-gear box is 1 1/2 threads per inch, and this happens to be the setting required, because $60 \div 1\ 1/2 = 40$, which represents one of the change-gear sizes. We have then:

$$\frac{420}{60} = \frac{70}{40} \times \frac{6}{1\ 1/2}$$

Therefore, in order to cut 4/7 thread per inch, the driving change-gear has 70 teeth, the driven change-gear 40 teeth, and the quick-change gearbox is set for cutting 1 1/2 threads per inch.

If the pitch of a special thread is such that the regular change-gears cannot be used, any special sizes must, of course, be within the practical limitations of the particular lathe to be used. The limiting factors will be the fixed gear centers, the largest idler gear available, and possibly the clearance within the gear guard or other interfering parts.

The accompanying table "Summary of Change-gear Formulas" is for the convenience of those who understand the principles explained in this article and want the formulas in handy form for future reference.

Nickel-Iron for Machine Parts Subjected to High Temperatures

The following information on metal intended for parts subjected to high temperature was given in a paper read before a meeting of the Society of Automotive Engineers by Thomas H. Wickenden of the International Nickel Co., Inc. There is a considerable demand for iron that will withstand temperatures such as babbitt and aluminum melting pots and pots for lead and salt baths are subjected to. While pots of special alloys have been developed that give very long life when used for such purposes, it has been found that an iron having a low silicon content with the addition of 1.50 to 2.00 per cent nickel and 0.50 to 0.75 per cent chromium will often increase the life to three to four times that of plain iron pots. Iron of this type has also been used around power plants for stoker links and for furnace castings.

A still better heat-resisting iron is a nickel-copper-chromium iron known as "Ni-Resist," which is the registered trademark applied to a composition patented by the International Nickel Co. A typical analysis of this type of iron shows the carbon content to be 3.00; silicon, 1.50; nickel, 14.00; copper, 6.00; and chromium, 2.50 per cent. This iron is being used in exhaust manifold control valves to prevent growth and scaling under heat. It is also used in stoker links, where it is said to have a life ten times that of low alloy iron.

This iron was originally developed as a corrosion-resisting material and shows very good resistance to waste acids. It can be secured in the form of pipe, fittings, and valves. It can be used for handling laboratory, pickling, and plating room wastes, but is not sufficiently resistant to corrosion to warrant its use in the construction of pickling tanks.

Experimental engines have been built with plain skirt type aluminum pistons having Ni-Resist liners, which have been found to operate satisfactorily with the same amount of piston clearance as is normally used with cast-iron pistons.

* * *

We must recognize that every new generation reaches maturity without knowing some of the hardships that the past generation has experienced; therefore, the new generation looks upon the same facts from a completely different point of view. If there is one function of research more important than another, it is this: To make people recognize that we are living in a state of change.—*Charles F. Kettering, vice-president and director, General Motors Corporation.*

Calculating Punching and Shearing Loads

Methods Employed in a Press Department to Prevent the Overloading of Presses Used in Shearing Heavy Plate

By ROBERT TWEEDSIDE

THE foreman of a heavy press department can usually tell when the load on a punch or shear press approaches the maximum capacity of the machine by the sound emitted, the slowing up of the flywheel, or the squeak of slipping belts. To avoid damage, such as cracked press frames, bent shafts, and broken gears, as a result of overloading, those responsible for assigning press work should know the rated capacities of all the available presses, and also should be able to estimate quickly the pressure required for each job.

The writer has seen a large press put out of commission for several weeks as a result of overloading, when a simple calculation would have shown that the job could not have been done as attempted. However, it would have been possible to handle the work if the gears and bearings had all been in first-class condition, the punches vertically staggered, and the work centrally located under the ram.

Capacity should be Marked on the Press

A good plan is to provide each machine with a stamped brass plate giving the user's machine number, the maker's name, size number, serial number, rated capacity in pounds, and the equivalent area of mild steel that can be sheared, assuming the shearing strength of the steel to be 50,000 pounds per square inch.

Modern machines are usually equipped with such a plate by the maker. In the case of an old machine, the maker will usually be able to supply the required data when the identity of the press is established. This may be done through the maker's serial number or by reference to the correspondence pertaining to the purchase of the machine, aided, possibly, by the die space drawing. All the information pertaining to each press should be on record in the drafting-room where the dies are designed, and it should also be marked on the drawings that show the available die space.

The following data for calculating shearing pressures is used by a well-known firm, and should be of special interest to designers and toolmakers.

For mild steel up to 0.08 per cent carbon content, allow an ultimate stress of 50,000 pounds per square inch of sheared area, assuming that there is no rake on the shear edges or vertical stagger of the punches. For example, assume that a rectangular hole 2 by 3 inches is to be punched in a plate of mild steel 1/2 inch thick and of 0.08 per cent carbon content. The area to be sheared equals the sum of the lengths of the four sides of the rectangular hole multiplied by the thickness of the stock. Thus the sheared area in this case is $10 \times 1/2 = 5$ square inches, and the load at a shearing stress of 50,000 pounds per square inch $= 50{,}000 \times 5$, or 250,000 pounds.

For every 0.01 per cent of carbon content above 0.08 per cent, add 550 pounds per square inch to the ultimate shearing stress, previously given as 50,000 pounds per square inch. For example, let

C = carbon content, in hundredths of 1 per cent; and

S = ultimate shearing stress, in pounds per square inch.

Then, $S = 50{,}000 + 550 \times (C - 8)$

Thus, for a steel of 0.18 per cent carbon content, the ultimate shearing stress would equal

$$50{,}000 + 550 \times (18 - 8) = 55{,}500 \text{ pounds}$$

For hot-punching at a temperature of 1060 degrees F., the load is only 40 per cent of that required to punch the same material when cold.

Giving Punches Vertical Stagger to Reduce Load

The load may be decreased considerably by giving rake or inclination to the shearing edges or vertical stagger to the punches. This distributes the load over a greater portion of the stroke, so that the total area in shear at one time will not be sufficient to exceed the capacity of the press. The difference in height between the highest and lowest cutting edges of punches having either rake or vertical stagger is usually made equal to the thickness of the stock, although it is sometimes made as great as twice the thickness of the stock. The load at any moment on punches having vertical stagger is found by adding together the area yet to be sheared by the punches that are in actual engagement with the work.

The rake or the stagger should extend in both directions from some central point outward toward the edges of the material, in order to distribute the load on the ram evenly and to prevent excessive end thrust. In general, the rake is applied to the punch when the flat stock around the hole forms the desired product, as the material removed by the punch is slightly deformed. The rake is applied to the face of the die when the part cut out by the punch is the product. In some cases, however, rake on both upper and lower cutting edges is an advantage.

In extreme cases, where heavy pressure, approaching the full capacity of the press, is distributed over as much as one-third or one-half of the stroke, it may be found that there is insufficient flywheel capacity to carry the ram smoothly over the dead center. This can be remedied by slightly increasing the speed or it can be wholly overcome by substituting a heavier flywheel, provided the other press members are heavy enough to permit this.

What May Be Expected From Non-Metallic Gears?

Principal Types of Non-Metallic Gears in General Use, Methods of Construction, and Means for Testing Gears of This Type*

By C. W. MANSUR
Plastics Department, Gear Division
General Electric Co., Lynn, Mass.

NON-METALLIC gears have been in use for hundreds of years. The first gears of this type doubtless were made of wood and called cog-wheels. One gear of a pair was made by driving pegs or pieces of wood into a round disk, the pieces protruding radially. The companion cog-wheel consisted of two flat disks separated sufficiently to permit the pegs of the other wheel to enter between them, but joined by wooden pins that engaged with the pegs. It was a simple arrangement with plenty of backlash and without tooth forms to worry about.

The modern non-metallic gear made from rawhide, fiber, rubber, cotton, and other vegetable fibers has been developed mainly to eliminate noise. Inaccuracies always creep in when it is attempted to reproduce a theoretical tooth form, and it is largely these inaccuracies that cause noise. A non-metallic gear aids in eliminating noise because the inaccuracies of the tooth face, as generated by the tools with which we have to work, are reduced to a minimum when the gears are in operation. The substance from which these gears are made is compressible and elastic, and therefore tends to conform with the tooth face of the mating metal gear.

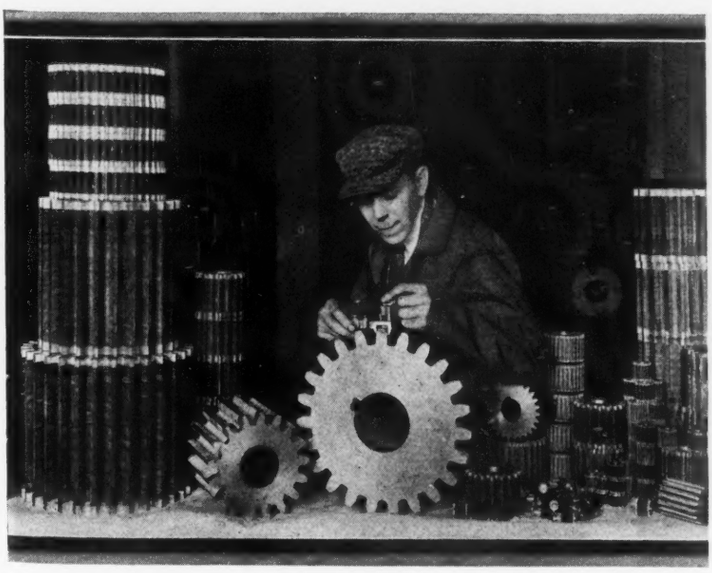


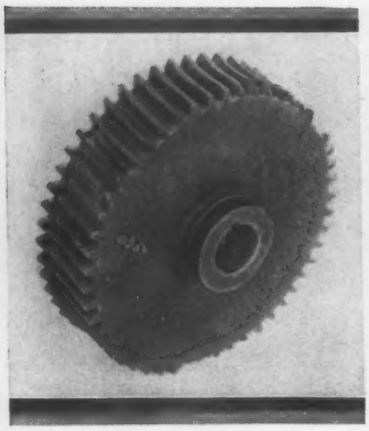
Fig. 1. Inspecting the Teeth of Fabroil Gears

The Development of Fabroil Gears

The all-cotton gear—known by the trade name of Fabroil—is held together mechanically by means of studs. Owing to the elasticity of its tooth face, as compared with metal, it is quiet and has a long life when applied for service for which it is suitable. If the load applied is not beyond the safe working stress of the material, it has been found that these gears will outwear several metal gears.

About twenty years ago, the first experiments were made with gears of this type by fastening together cloth buffing material by means of studs and end plates. Later, a fine-woven fabric was used, the material being compressed between side plates at a pressure of approximately 10,000 pounds per square inch. The end plates and the cotton were then fastened together by studs, and the blank was impregnated with oil.

*Abstract of paper read before the Annual Meeting of the American Gear Manufacturers' Association at Buffalo, May 7.



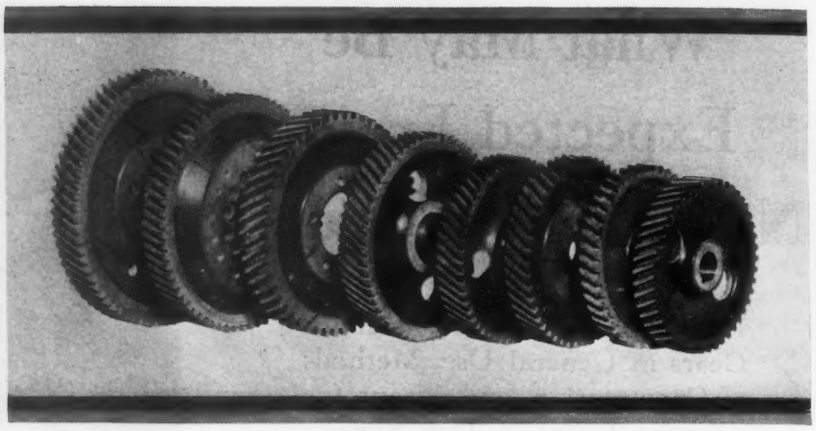


Fig. 2 (Left). Fabroil Worm-gear after 22,320 Hours' Service in Steam Turbine
Fig. 3 (Right). Typical Collection of Textolite Gears

Still later it was found that unspun cotton, such as batting, could be used, and when the pressure was increased to 16,000 or 18,000 pounds per square inch, a much stronger gear was obtained. These gears were still impregnated with oil after they had been assembled.

Then a special machine was developed for using cotton fiber treated with oil before compressing. This insures a more uniform distribution of both cotton and oil throughout the gear. By the use of oil in the construction of these gears, they become largely self-lubricating. Nevertheless, these gears should be lubricated by ordinary methods, if it is at all possible to do so. The heading illustration shows one of these gears in process of manufacture. Fig. 1 shows the teeth being inspected and checked. Fig. 14 is a diagram recording tests made on the flexibility of the teeth of one of these gears. This test was made on a gear with a face 1 1/4 inches between shrouds or end plates, using a pressure foot 1 inch wide.

Thousands of these gears have been used for timing gears, but owing to their weight and shroud limitations, they have been replaced by the well-known fabric resin gears known by the trade names Textolite, Micarta, Celeron, and Formica.

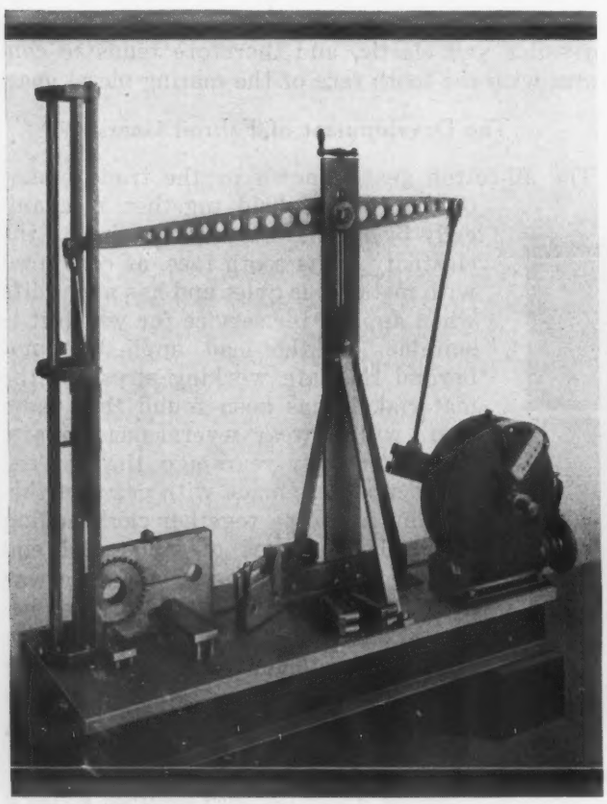


Fig. 4. Impact Gear-tooth Testing Machine

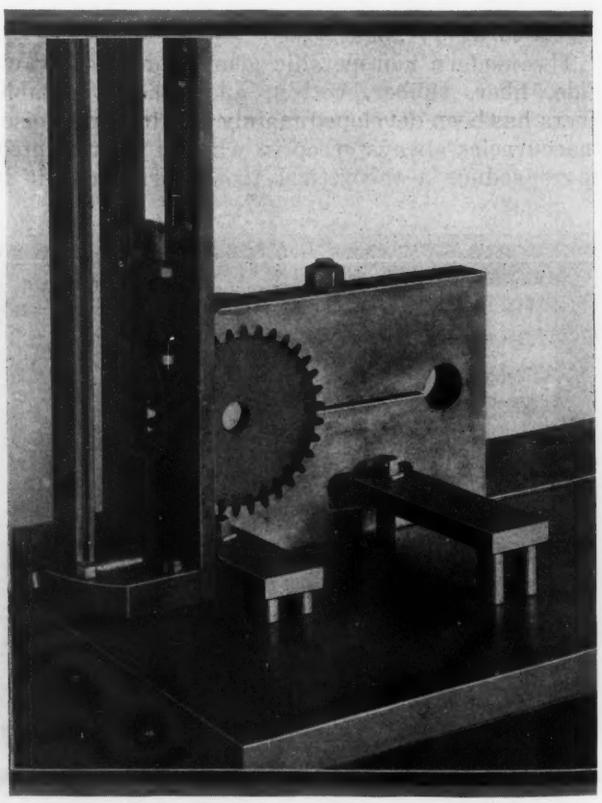


Fig. 5. Close-up View of Testing Machine

Fabroil is a good material for worm-gears. Fig. 2 shows a worm-gear of 4 diametral pitch, 2 1/2-inch Fabroil face, and 61 teeth, which was installed in a steam turbine in March, 1922. In April, 1925, the turbine was overhauled after the gear had run 22,320 hours. It is interesting to note what happened. The hub, which was of cast iron, was not sufficiently well secured, and the gear moved approximately 1/4 inch along its axis, but kept operating just the same. The indication is that the movement of the gear along its axis occurred early in its life.

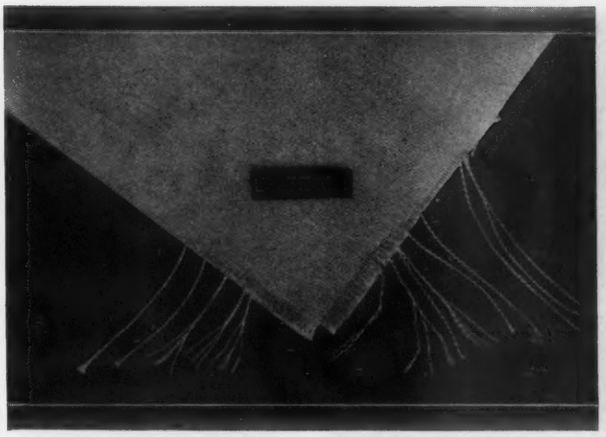


Fig. 6. Fabric Known as No. 10 Duck, Showing Structure Used in Manufacturing Textolite Gears

The Fabric Resin Type of Gear

The term "fabric resin" will be used for gears composed of a fabric such as duck, drill sheeting, or other spun and woven textile fibers held together in laminated form by means of a resin such as Bakelite, Durez, Durite, or other phenolic condensation product.

The development of this type of material was started about 1916. Since that time, a great deal of research work has been done to make this material as perfect as possible. It was found that it was not enough to just dip the fibrous material in a thin solution of phenolic resin varnish and hang it up to dry for a few days before pressing it into gears. The resin and varnish has been gradually changed to obtain more satisfactory results. The resin coating is now more scientifically applied, and all the operations are under strict laboratory control.

It is very important that material of this kind be heat-treated thoroughly after molding to remove the stresses caused by high pressures and to shrink the material so that no changes will take place in an accurately cut gear after it is completed.

Die-Formed Bakelized Canvas Gears

Most of the early automobile timing gears were made by turning or machining them from a solid piece cut from board material. This prompted the design and development of die-formed gear blanks—that is, blanks molded in individual molds with a rim of predetermined width and with a web that is quite thin. In many cases, these blanks can be so designed that the web thickness is only one-fifth that of the rim. Metal hubs can be molded in the center of these gears, provided the outer periphery

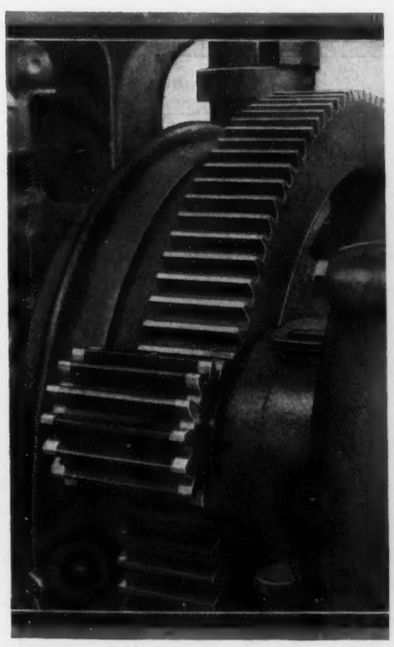


Fig. 7. Fabroil Pinion, 14 Teeth, 5 Diametral Pitch, Transmitting 5 Horsepower at 1200 Revolutions per Minute

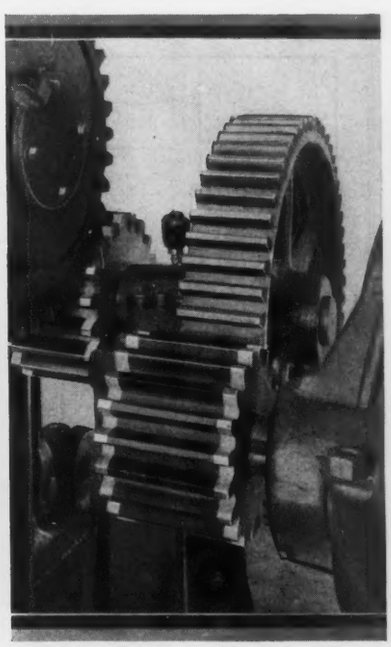


Fig. 8. Fabroil Pinion, 19 Teeth, 1 1/2-inch Circular Pitch, 5 1/2-inch Face, Applied to a Textile Machine

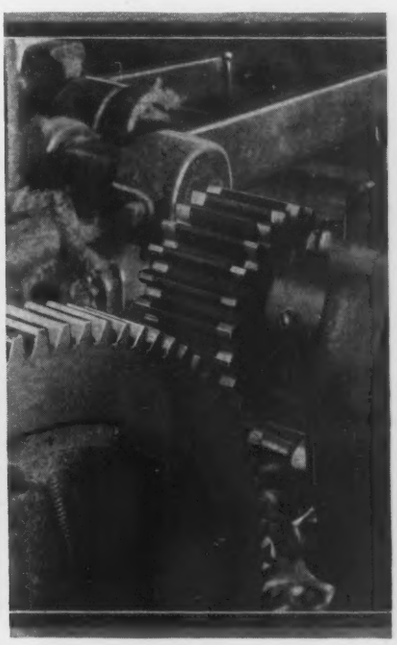


Fig. 9. Fabroil Pinion, 23 Teeth, 5 Diametral Pitch, Transmitting 2 Horsepower at 1200 Revolutions per Minute

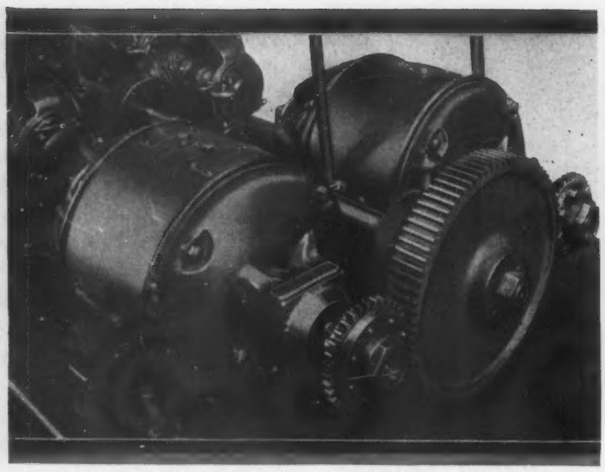


Fig. 10. Geared Motor-Generator Set for Testing Non-metallic Gears

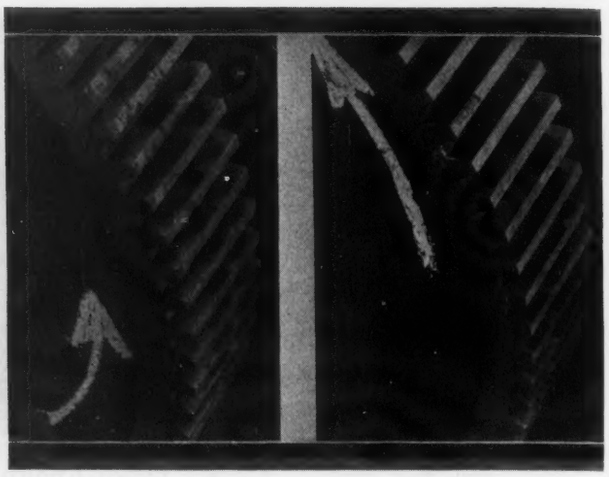


Fig. 11. Idler Metal Gear Showing Tooth Contact with Non-metallic Gears

of the hub has sufficient knurled projections and there is enough material around this knurled hub to prevent it from becoming loose.

Fig. 3 shows a collection of early gears of this type. Gradually, individual molded blanks were made for the general run of industrial gears, such as are used in machine tools, for example. Such blanks are made by cutting the laminations from the treated sheet fabric and then molding them into a disk or gear blank in individual molds. This method has two distinct advantages. The first is that successive laminations can be rotated with relation to each other, so that the threads of the fabric are radial and in a fan-shaped position around the blank. This is why the individual blank has an advantage over board material. The fabric is woven with the filling threads at 90 degrees from the warped threads; therefore, in making boards, all that can be done economically is to cut the sheet square and turn alternate sheets 90 degrees from each other.

The other distinct advantage of this molded blank is that it can be heat-treated more uniformly than a board 35 by 35 inches or 35 by 42 inches in size. This makes it possible to eliminate any change in shape after the gear is cut.

As mentioned, it is not enough to take woven fabric of any degree of strength, soak it in a phenolic

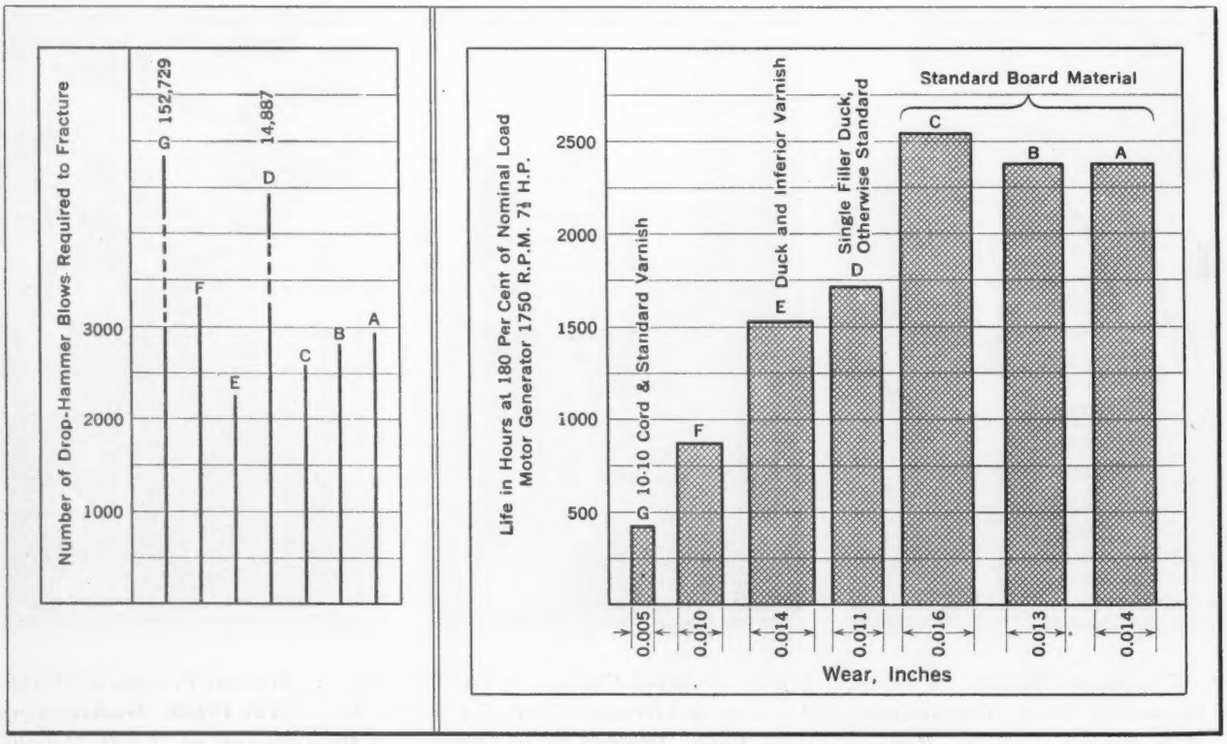


Fig. 12. Diagram Based on Tests Made on Textolite Gears

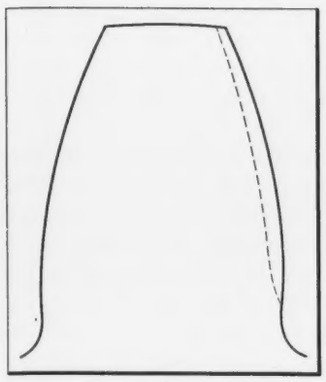


Fig. 13. Wear of Non-metallic Gear Tooth after 3100 Hours' Service at 80 Per Cent Overload

varnish, and then press the layers together to form a laminated gear material. The woven fabric must be specially designed and of high quality, closely woven to give maximum strength. Fig. 6 shows the structure of the fabric used for making Textolite gears. The resin and varnish must also be of uniform quality.

The cotton fabric gives the gear tooth its strength and flexibility. It must, however, be held immovable by the binding resin. The right amount of resin in proportion to the quantity of fabric is of importance in obtaining maximum flexibility and strength with the least amount of change due to heating and cooling when in operation. This is especially important for gears that operate in hot oil, and contain, at times, relatively high percentages of water and gasoline, such as are found in a motor crankcase. When properly made, however, the product may be said to be of unchangeable quality.

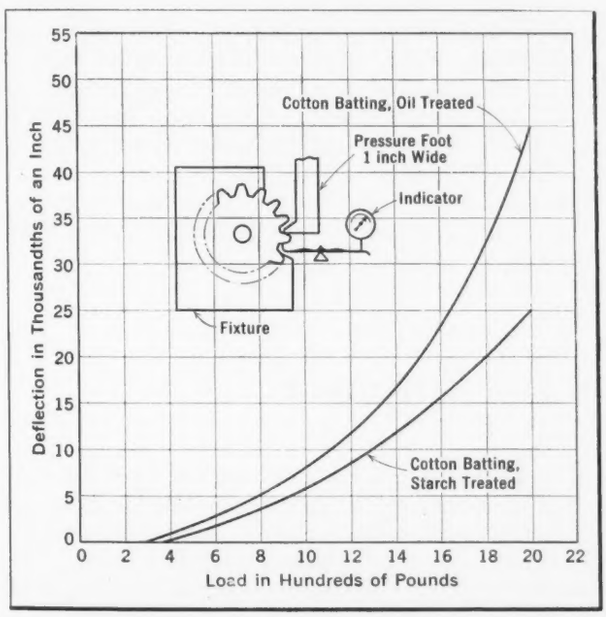


Fig. 14. Diagram Recording Breaking Tests on Fabroil Gears, 4 Diametral Pitch, 16 Teeth

Testing Non-Metallic Gears

For making the impact, tooth strength, and operation tests, gears of 6 diametral pitch, 33 teeth, and 1/2-inch face are cut. Fig. 4 shows the impact drop-hammer testing machine used for determining the impact strength of the teeth. Fig. 5 is a close-up view, indicating how the gear is held.

In cutting these gears, it is very important that the same type of hob be used for all of them, so as to obtain gears as nearly identical as possible. The gears that are to operate on the same motor-generator are both cut at the same time in order to eliminate variations as far as possible.

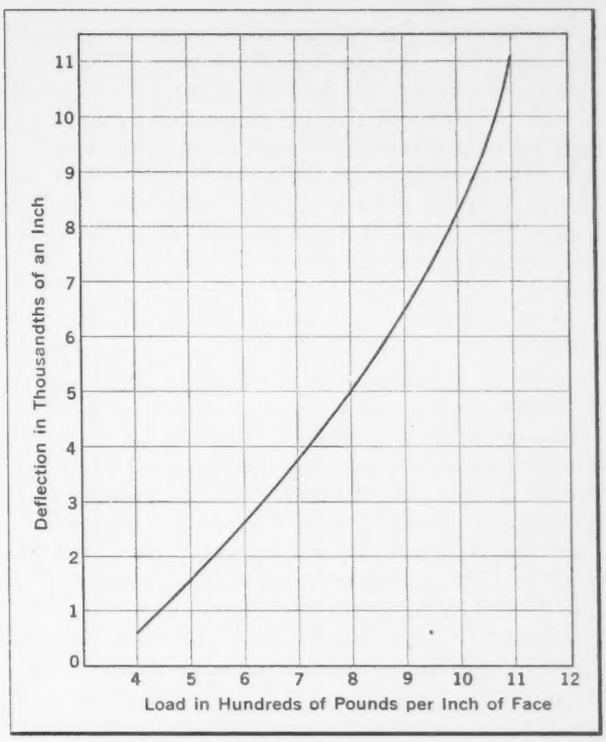


Fig. 15. Diagram of Breaking Test on Textolite Gear

Fig. 10 shows the running tests to which these gears are subjected. A motor-generator set is used, having a motor of 7 1/2-horsepower capacity running at 1850 revolutions per minute, and driving a generator that pumps current back into the line. The load is 80 per cent above the normal load calculated for gears of the size mentioned. There is

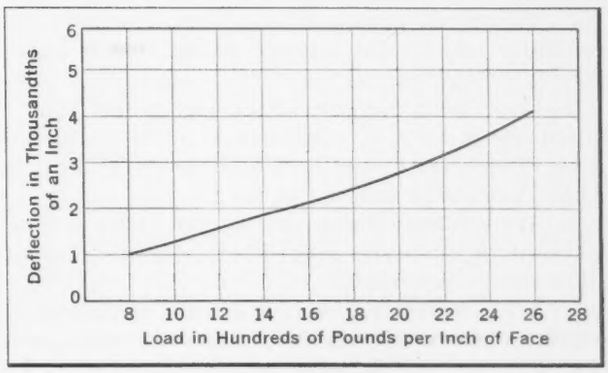


Fig. 16. Diagram of Breaking Test on Cast-iron Gear

an idler gear made from hardened steel, with ground teeth, operating between the two gears to be tested. This idler is mounted on a shaft revolving in ball bearings. The two gears to be tested are changed every 100 hours—that is, the gear on the generator is placed on the motor and vice versa. This is done to eliminate uneven results in the test. Fig. 11 shows the tooth contact marks on the hardened and ground idler after a test had been run for a period of time.

The diagram Fig. 12 indicates some of the results that have been obtained in these tests. The examples to the right, marked *A*, *B*, and *C*, show the results obtained in testing gears made from what may be called standard materials. The width of the cross-sectioned area represents the wear, and the height the run in hours. To the left in the illustration are shown the results of three impact tests corresponding to the three operation tests *A*, *B*, and *C*.

At *D* is shown a test on a different fabric. The wear was 0.011 inch in 1700 hours. When tested for impact, this material, however, withstood nearly 15,000 blows, while the materials *A*, *B*, and *C* withstood only 3000 blows. This indicates a very different structure of the material, and shows, also, that it is not safe to be guided by impact-test results alone. Wear tests must also be made.

At *E* are shown test results made by a gear constructed from a regular fabric—the same as *A*, *B*, and *C*—but with an inferior resin. The wear was 0.014 inch in 1525 hours. At *F* is shown another material, which proved not to be satisfactory, having a short life, low wear factor, and low impact test value. The material indicated at *G* is very interesting. This is a special fabric made from large threads—10-10 cord—practically all warp with very light filler. Here the wear factor is very low, while the impact test is high—it took 152,729 blows to break the tooth.

Fig. 13 indicates the nature and amount of wear on a tooth of one of these test gears after 3100 hours. Fig. 15 shows the deflection curve of one of these gears tested by the method previously mentioned, while Fig. 16 shows the deflection curve for a cast-iron gear. In the case of the fabric gear, the deflection starts at 400 pounds and amounts to about 0.0005 inch. At least part of this is due to the compressibility of the tooth face at the line of contact with the pressure foot. From this point on deflection takes place rapidly as the load increases.

With the cast-iron tooth, again, no deflection takes place below 800 pounds, and the deflection is less marked from this point on until the breaking load is reached. Owing to this lack of elasticity of cast iron, pitting and rapid wear will take place at the point of contact when the pressures become high. This pitting and wear is not present in the non-metallic materials within the load limits for which the material is suitable.

It is very important that all types of non-metallic gears should be properly aligned. There are many installations where improper fastening of the motor to the frame of the machine causes short life and failure of the gears. Although a non-metallic gear has a relatively flexible tooth which will compensate for slight inaccuracies, proper installation and alignment should be given careful consideration. Figs. 7, 8, and 9 show typical applications of non-metallic gears.

Twelve Questions for Foremen

The following questions, formulated by *Management*, a publication issued by the Elliott Service Co., New York City, will undoubtedly be of interest to executives and foremen.

1. Are you seriously interested in every factor that contributes to greater success and better profits for your company?

2. Would you prefer to work for a company that regularly operates at a profit or one that is barely getting by, so long as your job is secure?

3. Does your company have any policy that is unpopular with your workers? If so, how much of that unpopularity may be traced to the manner in which you carry out the policy?

4. Are you sure that every worker under you has a thorough understanding of the reasons back of all company policies?

5. Are you perfectly satisfied with the manner in which company policies are followed by your men?

6. Do you govern your acts by the knowledge that the success of an organization is dependent upon the cooperation of its departments?

7. In making decisions, do you always consider how your decision will affect company profits?

8. Do you agree with those who believe that the performance that contributes most to company success will, in the end, contribute most to your individual success?

9. Are you constantly on the alert to introduce improvements that will help increase profits?

10. If you feel that a new policy is likely to be unpopular, do you introduce it apologetically to your workers or do you try to get them to see the necessity for the policy?

11. Do you abide by the same rules and regulations that you enforce among the men?

12. Do you honestly believe you are above or below the average among the supervisors in your organization in the contribution you are personally making to the success of your company?

* * *

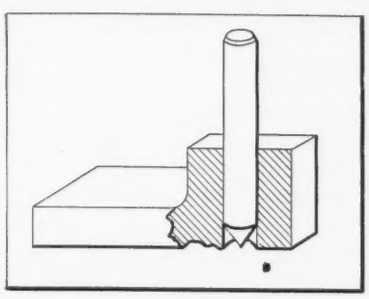
Don't base conclusions on opinions when facts are available.

Ideas for the Shop and Drafting-room

Time- and Labor-saving Devices and Methods that Have been Found Useful by Men Engaged in Machine Design and Shop Work

Guide for Spotting the Position of Drilled Holes

In drilling work laid out by means of a center-punch, the drill often tends to run off from the punch mark. This can be prevented to a great extent by employing the device shown in the illustration. It consists of a drill guide and a locating punch. The guide is moved about on the face of the work until the point of the punch enters the punch mark, after which the guide is clamped to the work.



Guide for Starting a Drill Correctly in Relation to a Punch Mark

The punch is next removed and the work is spotted with a drill of a size equal to that of the punch. The guide is then removed from the work, after which the hole is drilled. The guide is made of tool steel and hardened. It is important, of course, that the point of the punch be ground concentric with the body.

Meriden, Conn. P. L. BUDWITZ

Indicating Finish

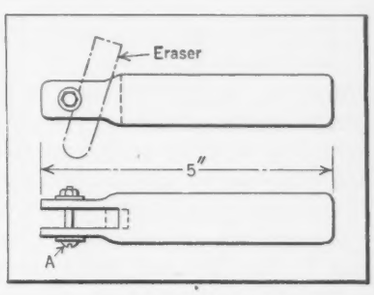
Referring to the discussion on methods of indicating finish on page 690 of May MACHINERY, the writer would suggest that when another finish is required than that indicated by the symbol *f*, which generally is used for regular machine finish on castings, it would be preferable to use a note on the drawing describing the kind of finish wanted, with an arrow pointing to the finished surface. This would eliminate any possible chance for errors, either in the pattern shop or in the machine shop.

On the same page of May MACHINERY it is pointed out by a contributor that when dimensions are not to scale, they should be underscored to indicate that they should not be measured or scaled. The writer believes that all drawings should have stamped upon them the injunction "Do not scale." If a dimension is in doubt, the matter should be taken up with the person who is responsible for the drawing. To scale a drawing is to work by guess.

Philadelphia, Pa. GEORGE A. FRIES

Wooden Grip for Ink Eraser

The job of erasing obsolete information and details on ink tracings is a tedious one at best. When extensive changes are necessary, the hand often becomes painfully cramped as a result of gripping the eraser tight enough to obtain a clean erasure.



Convenient Device for Holding an Ink Eraser

A handy grip for the eraser, which will help avoid this trouble, is shown in the accompanying illustration. It is made from a piece of the wooden stick about which tracing paper is rolled. The end of the stick is slotted to give a fairly loose fit for the eraser, which is clamped in place at any desired angle by tightening the nut on the 8-32 machine screw *A*. Washers are placed under the head and the nut of the machine screw.

Philadelphia, Pa. J. ROLAND HENHOEFFER

Scribing Diametrically Opposite Lines on Cylinder

To scribe two lines diametrically opposite each other on the surface of a cylindrical piece often involves considerable "cut and try" marking before the job is done satisfactorily. A simple method used by the writer when there are two or more pieces to be scribed is shown diagrammatically in the illustration. Of course, the diameter of the pieces must be large enough to permit the scriber to be used as illustrated.

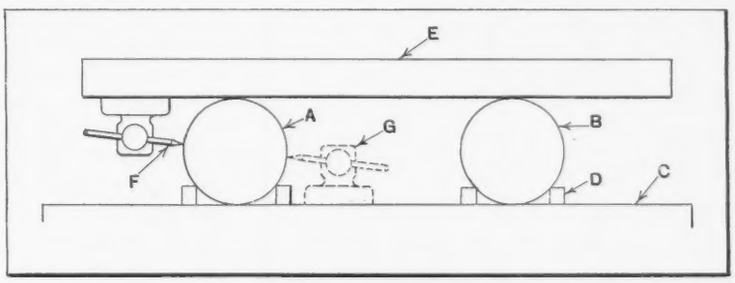
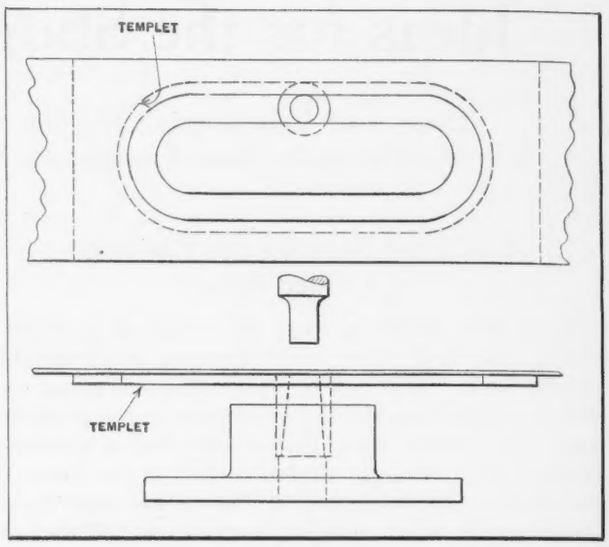


Diagram Illustrating Method of Scribing Diametrically Opposite Lines on Rolls

First, the two pieces *A* and *B* to be scribed are placed on the surface plate *C*, and blocks *D* are arranged to prevent the pieces from moving or rolling. The parallel *E* is then placed on top of the rolls and the scriber *F* of the surface gage used to scribe the line on one side of roll *A* by sliding its base along the under side of the parallel *E*.

The scriber is, of course, first adjusted to approximately the center height of the roll. The line on the other side of the roll is scribed diametrically opposite the first line by resting the surface gage on plate *C*, as indicated by the dotted lines at *G*. It is obvious that the lines thus scribed are opposite, even though the scriber point is not adjusted to the exact center height of the roll. The same procedure is employed in scribing the lines on roll *B*.

Hamilton, Ontario, Canada — H. MOORE



Die in which a Templet is Employed to Guide the Punch while Cutting out Irregular Shapes from Sheet Metal

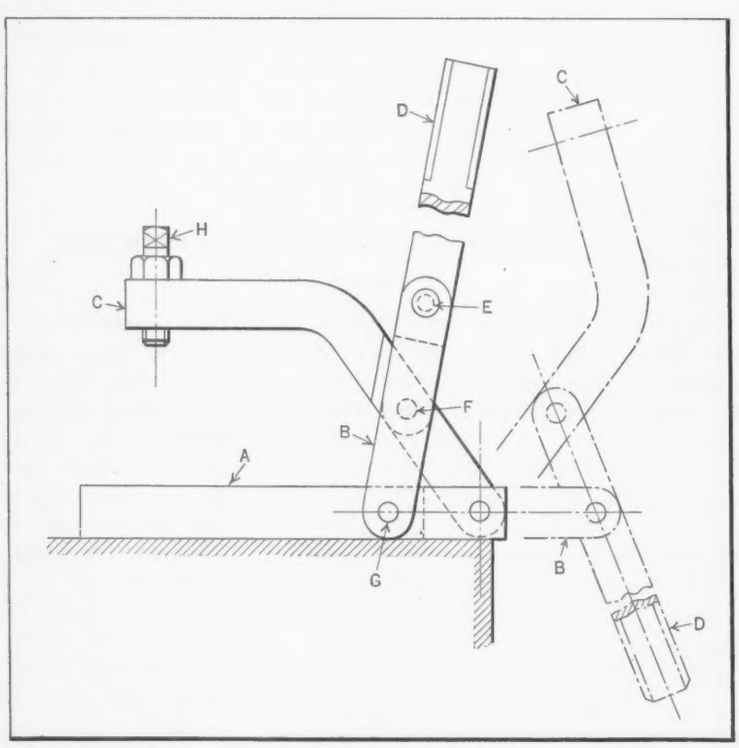
Cutting out Irregular Shapes in a Power Press

A rather simple method of cutting out irregular shapes from sheet metal by means of a templet is shown in the illustration. A simple die is used, the punch being of a round cross-section. The punch enters a bushing that protrudes a short distance from the top of the die. Its action is similar to that obtained in a nibbling machine.

To cut out a piece of work, a templet corresponding to the finished work is secured to the blank either by soldering or clamping. The blank is then placed as shown on top of the die bushing, the contour edge of the templet being in contact with the outside circumference of the bushing. The press is now tripped, allowing the punch to reciprocate continuously. The operator grips both the blank and the templet and moves them along, keeping the edge of the templet against the side of the bushing. This movement is continued until the punch has cut out the required contour.

Before starting the punching operation, a hole slightly larger than the punch is drilled in the blank, as the die is not equipped with a stripper plate. The press used for this work is of the high-speed type, so that a fairly slow feeding movement of the blank will produce a smooth job.

Philadelphia, Pa. — CHARLES KUGLER



Swing-over Toggle Clamp with Open Position Shown by Dot-and-dash Lines

Swing-Over Toggle Clamp

Many simple, quick-acting clamps have been evolved for manufacturing equipment, and while the one here illustrated may not be entirely new to all readers, it merits the consideration of tool designers in general. The rectangular supporting strip *A* is secured to a bench or machine tool table. This strip carries two pins for the links *B* and clamp *C*. The handle *D*, which has a combined locking and swinging-over motion, carries two pins *E* and *F*.

The end of handle *D* is forked to fit over the clamp *C*, to which it is connected by pin *F*. The two links *B*, one on each side, are connected to handle *D* by pin *E*. The opposite ends of links *B* are pivoted on the fixed pin *G* in the strip *A*. The adjusting screw *H* and its lock-nut provide adjustment for the locking position of handle *D* and its linkwork. The links *B* throw the handle and clamp over clear of the work when in the open position indicated by the dot-and-dash lines.

Cartierville, Canada — T. WRIGLEY

INDEXING MOVEMENTS FOR ANGLES—9

Angle in Degrees, Minutes, and Seconds			B. & S., Becker, K. & T., Hendey, and Rockford		Cincinnati and LeBlond		Angle in Degrees, Minutes, and Seconds			B. & S., Becker, K. & T., Hendey, and Rockford		Cincinnati and LeBlond	
Deg.	Min.	Sec.	No. of Holes	Circle	No. of Holes	Circle	Deg.	Min.	Sec.	No. of Holes	Circle	No. of Holes	Circle
7	3	31.7	..	..	40	51	7	32	25.9	31	37	31	37
7	4	17.1	..	..	33	42	7	32	54.1	26	31	52	62
7	5	6.3	37	47	37	47	7	33	36.0	..	..	21	25
7	5	27.2	26	33	52	66	7	34	44.2	16	19	48	57
7	6	18.9	15	19	45	57	7	35	17.6	..	..	43	51
7	6	46.4	..	..	49	62	7	36	12.4	..	..	49	58
7	6	58.6	34	43	34	43	7	36	55.3	33	39	33	39
7	7	30.0	..	..	19	24	7	37	37.6	..	..	50	59
7	7	55.4	..	..	42	53	7	37	49.5	..	..	39	46
7	8	16.5	23	29	46	58	7	38	10.9	28	33	56	66
7	8	49.4	..	..	27	34	7	38	29.4	..	..	45	53
7	9	13.8	31	39	31	39	7	39	0	17	20	..	..
7	9	47.7	39	49	39	49	7	39	34.4	40	47	40	47
7	10	0	..	..	43	54	7	40	0	23	27	46	54
7	10	10.1	..	..	47	59	7	40	35.2	..	..	29	34
7	12	0	16	20	24	30	7	40	58.5	35	41	35	41
7	13	38.1	..	..	53	66	7	41	36.7	..	..	53	62
7	14	7.0	..	..	41	51	7	42	51.4	42	49	42	49
7	14	20.8	..	..	37	46	7	44	12.6	..	..	49	57
7	14	38.0	33	41	33	41	7	44	39.0	37	43	37	43
7	15	29.0	25	31	50	62	7	45	31.0	25	29	50	58
7	15	47.3	..	..	46	57	7	45	52.9	..	..	44	51
7	16	35.7	38	47	38	47	7	46	21.8	..	..	57	66
7	17	8.5	17	21	34	42	7	46	46.7	..	..	51	59
7	17	35.1	..	..	47	58	7	47	1.6	32	37	32	37
7	17	50.2	30	37	30	37	7	48	0	13	15	26	30
7	18	6.8	..	..	43	53	7	48	40.7	..	..	46	53
7	18	45.0	13	16	..	..	7	48	56.8	..	..	33	38
7	19	19.3	..	..	48	59	7	49	33.9	20	23	40	46
7	19	32.0	35	43	35	43	7	50	0	..	..	47	54
7	20	0	22	27	44	54	7	50	19.3	27	31	54	62
7	20	31.5	..	..	31	38	7	50	46.1	34	39	34	39
7	20	49.0	40	49	40	49	7	51	3.8	41	47	41	47
7	21	49.0	27	33	54	66	7	52	30.0	14	16	21	24
7	23	4.6	32	39	32	39	7	53	41.0	..	..	50	57
7	23	34.2	..	..	23	28	7	53	52.6	43	49	43	49
7	24	11.6	..	..	51	62	7	54	8.7	36	41	36	41
7	24	42.3	14	17	42	51	7	54	32.7	29	33	58	66
7	25	15.7	..	..	47	57	7	54	49.6	..	..	51	58
7	26	5.2	19	23	38	46	7	55	12.0	..	..	22	25
7	26	53.8	24	29	48	58	7	55	42.8	..	..	37	42
7	27	48.3	34	41	34	41	7	55	55.9	..	..	52	59
7	28	5.1	39	47	39	47	7	56	28.2	15	17	45	51
7	28	18.1	..	..	44	53	7	57	12.5	38	43	38	43
7	28	28.4	..	..	49	59	7	58	52.0	..	..	47	53
7	30	0	15	18	45	54	7	59	1.9	..	..	55	62
7	31	50.2	41	49	41	49	8	0	0	16	18	48	54
7	32	5.5	36	43	36	43	8	1	18.2	..	..	41	46

Copyright, 1931, The Industrial Press, New York

MACHINERY'S Data Sheet No. 205, New Series, July, 1931 Contributed by Edgar F. Hedden

INDEXING MOVEMENTS FOR ANGLES—10

Angle in Degrees, Minutes, and Seconds			B. & S., Becker, K. & T., Hendey, and Rockford		Cincinnati and LeBlond		Angle in Degrees, Minutes, and Seconds			B. & S., Becker, K. & T., Hendey, and Rockford		Cincinnati and LeBlond	
Deg.	Min.	Sec.	No. of Holes	Circle	No. of Holes	Circle	Deg.	Min.	Sec.	No. of Holes	Circle	No. of Holes	Circle
8	1	37.2	33	37	33	37	8	28	14.1	16	17	48	51
8	2	8.5	..	..	25	28	8	29	26.0	..	..	50	53
8	2	33.1	42	47	42	47	8	30	0.0	17	18	51	54
8	2	43.6	..	..	59	66	8	30	48.6	35	37	35	37
8	3	9.4	17	19	51	57	8	31	34.7	18	19	54	57
8	4	8.2	26	29	52	58	8	32	4.1	..	..	55	58
8	4	36.9	35	39	35	39	8	32	18.4	37	39	37	39
8	4	53.8	44	49	44	49	8	32	32.5	..	..	56	59
8	5	5.0	..	..	53	59	8	33	0.0	19	20	..	..
8	6	0	18	20	27	30	8	33	39.5	39	41	39	41
8	7	3.5	..	..	46	51	8	33	52.2	..	..	59	62
8	7	19.0	37	41	37	41	8	34	17.1	20	21	40	42
8	7	44.5	28	31	56	62	8	34	53.0	41	43	41	43
8	8	34.2	19	21	38	42	8	35	27.2	..	..	63	66
8	9	3.4	..	..	48	53	8	36	31.3	22	23	44	46
8	9	46.0	39	43	39	43	8	37	1.2	45	47	45	47
8	10	0.0	..	..	49	54	8	37	30.0	..	..	23	24
8	10	54.5	30	33	60	66	8	37	57.5	47	49	47	49
8	12	21.1	..	..	31	34	8	38	24.0	..	..	24	25
8	12	37.9	..	..	52	57	8	38	49.4	..	..	49	51
8	13	2.6	21	23	42	46	8	39	37.3	..	..	51	53
8	13	26.9	..	..	53	58	8	40	0.0	26	27	52	54
8	14	2.5	43	47	43	47	8	40	42.8	..	..	27	28
8	14	14.2	..	..	54	59	8	41	3.1	..	..	55	57
8	15	0.0	..	..	22	24	8	41	22.7	28	29	56	58
8	15	55.1	45	49	45	49	8	41	41.6	..	..	57	59
8	16	12.9	34	37	34	37	8	42	0.0	..	..	29	30
8	16	27.0	..	..	57	62	8	42	34.8	30	31	60	62
8	16	48.0	..	..	23	25	8	43	38.1	32	33	64	66
8	17	22.1	..	..	35	38	8	44	7.0	..	..	33	34
8	17	38.8	..	..	47	51	8	45	24.3	36	37	36	37
8	18	27.6	36	39	36	39	8	45	47.3	..	..	37	38
8	19	5.4	..	..	61	66	8	46	9.2	38	39	38	39
8	19	14.7	..	..	49	53	8	46	49.7	40	41	40	41
8	20	0.0	25	27	50	54	8	47	8.5	..	..	41	42
8	20	29.2	38	41	38	41	8	47	26.5	42	43	42	43
8	21	25.7	..	..	39	42	8	48	15.6	..	..	45	46
8	22	6.3	..	..	53	57	8	48	30.6	46	47	46	47
8	22	19.5	40	43	40	43	8	48	58.7	48	49	48	49
8	22	45.5	27	29	54	58	8	49	24.7	..	..	50	51
8	23	23.3	..	..	55	59	8	49	48.6	..	..	52	53
8	24	0	14	15	28	30	8	50	0.0	..	..	53	54
8	24	46.9	..	..	43	46	8	50	31.5	..	..	56	57
8	25	9.6	29	31	58	62	8	50	41.3	..	..	57	58
8	25	31.9	44	47	44	47	8	50	50.8	..	..	58	59
8	26	15.0	15	16	..	..	8	51	17.4	..	..	61	62
8	26	56.3	46	49	46	49	8	51	49.0	..	..	65	66
8	27	16.3	31	33	62	66	..	..	....	..	..	..	..

Copyright, 1931, The Industrial Press, New York

MACHINERY'S Data Sheet No. 206, New Series, July, 1931 Contributed by Edgar F. Hedden

Indexing Jig for Drilling Bolt Circles

By PAUL LEO, Elizabeth, N. J.

The production of a few parts, such as may be required in experimental work, is often expensive. Small quantities do not usually warrant large expenditures for production tools, although the cost of laying out work manually is sometimes so great as to demand a jig that can be made quickly at small cost, and yet be reasonably accurate.

An example of this type of jig is shown in Figs. 1 and 2. In this jig, bolt circles are drilled in two different cast-iron flanges by means of one drill bushing. Simple design and economical construction were employed here, as the quantity of parts to be drilled did not warrant more expensive equipment.

One of the flanges to be drilled (see Fig. 1) is provided with center holes and is supported in the jig by means of centers *I* and *H*. The other flange (not shown) is bored through its center, and is pressed on the short arbor shown at *J* for the drilling operation. The arbor and casting are then supported between the centers *I* and *H* in the same manner as the other flange.

Referring to the construction of the jig, the frame consists of the cold-rolled steel plates *B* and *D*, which are connected at their ends by the two columns *C*. In plate *D* are secured the drill bushing *E*, bushing *F*, in which the indexing pin *G* is a sliding fit, and the movable center *I*.

In plate *B* are mounted the stationary center *H* and the spring-actuated plunger *K*. This plunger supports the flange directly beneath the drill and is spotted at the top to allow the drill to pass through the work. It is secured firmly in position by the set-screw in block *L* after the casting has been mounted between the centers. At the lower end of block *L* is turned a concentric shank which fits plate *B* and serves to locate the block central with the drill bushing *E*.

The central hole in plate *D*, through which the upper center is a close sliding fit, is countersunk at an included angle of about 54 degrees to correspond with the bevel on the collet *M*. This collet is so heat-treated that it is machineable and

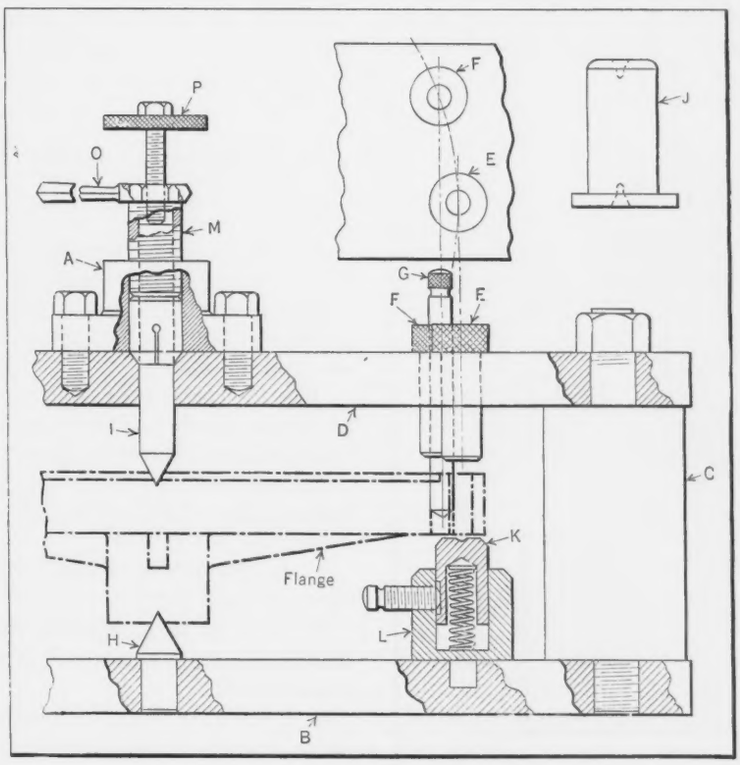


Fig. 1. Jig in which Only One Drill Bushing is Used to Drill an Entire Bolt Circle

does not require subsequent grinding. It is threaded externally at its upper end to fit the tapped portion of hub *A* closely. The upper end of the collet is milled to a hexagonal shape to fit the box wrench *O* which serves to lock and unlock the upper center. This center is brought into contact with the work or arbor by means of the adjusting screw *P*, which is merely a cap-screw threaded tightly into a heavy knurled washer.

In operation, one hole is drilled first, using the bushing *E* as a guide for the drill. The flange is then rotated until the drilled hole is in alignment with the hole in bushing *F*, after which the pin *G* is passed through bushing *F* and the drilled hole. The next hole is then drilled, again using the bushing *E* as a guide. Each successive hole is drilled in this manner.

In unloading the work from the jig, the screw *P* is first backed off and the collet unlocked, whereupon a light upward pressure on the work will raise the center *I* enough so that the work can be removed. It is obvious that by providing radial adjustment of the drill bushing and indexing pin bushing, work having bolt circles of various diameters can be handled.

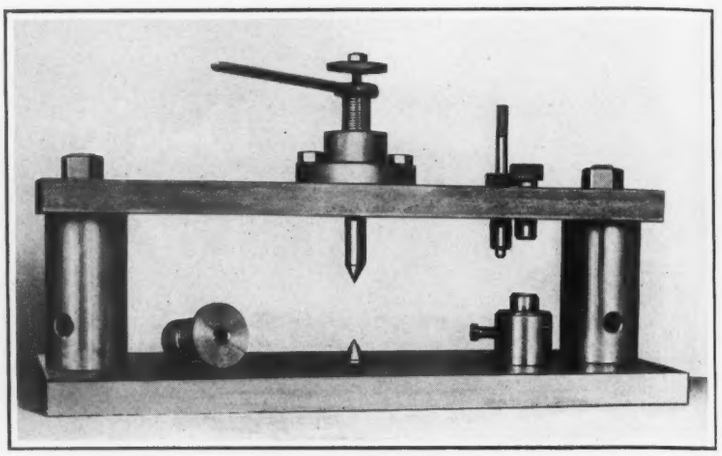


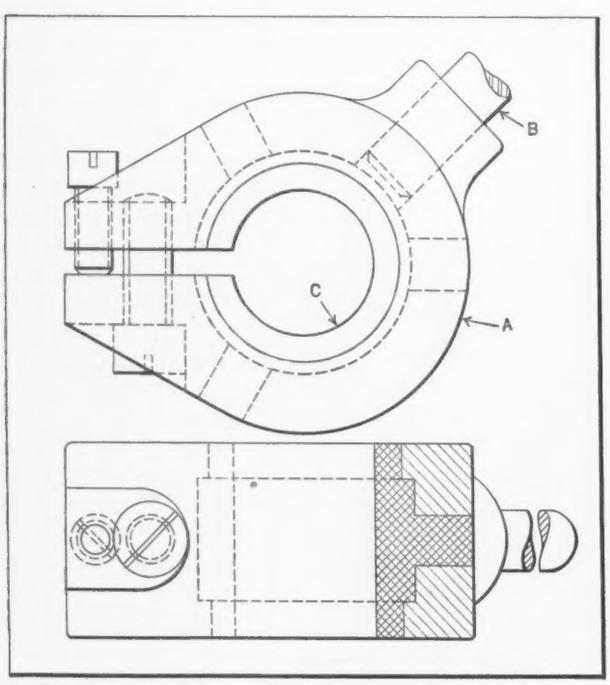
Fig. 2. Indexing Jig for Drilling Bolt Circles

Lapping Tool for Cylindrical Surfaces

By W. N. DELENK, Machine and Tool Engineer
Cleveland, Ohio

In the illustration is shown a lapping tool of the adjustable type which is used for lapping cylindrical surfaces accurately. This tool consists of the cast-iron member *A* which is split at one side and provided with screws by means of which adjustment can be made to compensate for wear. The inside of member *A* is recessed to facilitate the molding of the lead lining *C* which serves as a lapping surface. A long lever *B* is mounted in one side of the lap to provide a means of holding it while in operation.

In use, the powdered abrasive and oil are deposited on the inner surface of the lap, and the lap is pushed over the shaft and operated in the usual manner. Lead is claimed to be superior to other materials for use in this type of lap, inasmuch as the abrasive grains embed themselves in the lead and are held in place until the grains are worn out; whereas, with a harder material, the grains continually change their position, causing excessive wear of the lap. Moreover, the molding of these laps is inexpensive, as the old lining can be easily melted out and a new one poured in a short time.



Adjustable Lapping Tool with Lead Lining

Checking List for Tool Drawings

By D. BAKER, Long Island City, N. Y.

In order to reduce the number of errors that might occur while making a tool drawing, the writer compiled a checking list. This list, although it fits only one line of work, may be altered to suit other lines also.

The list tabulates all the errors that are likely to occur. It should be located on the drawing board in a position where it can be referred to easily while checking the drawing. Incidentally, the number of errors a list of this type will uncover is remarkable. The list is as follows:

1. Is the outline of the part to be machined accurately laid out?
2. Have design, ease of operation, best locating points, efficient clamping, and chip clearance been considered?
3. Is there any interference between fixture and parts which would prevent rapid loading and unloading?
4. Can the tool parts be machined readily?

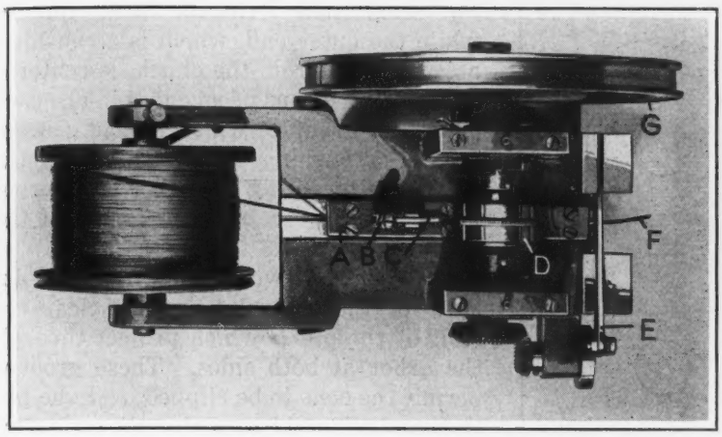


Fig. 1. Top View of Machine, Showing how the Wire is Fed by Rolls to the Shear Knife to be Cut off

5. Are all important dimensions, over-all dimensions, and other dimensions given and correct?

6. Have finish marks been included?

7. Have the necessary notes been added, such as the specifying of heat-treatment, holes to be drilled, reamed, tapped, etc.?

8. Is a material list included, giving detail numbers and standard part numbers?

Referring to Item 1, the outline of the part is usually drawn first in colored ink or pencil and the fixture designed around it. The importance of having this outline correct and exactly to scale is obvious; yet mistakes are often made in drawing the outline that seriously affect the finished fixture.

Item 2 calls attention to the fact that a tool should be studied to see that it is simple and easy to operate. A little thought as to how the fixture is to be placed on a machine, the direction of feed, the location of the operator in relation to the feed-screws or other operating mechanism, the sequence of motions required of the operator, and lastly how an operator should use his hands in loading and unloading the fixture, will have an important bearing on the efficiency of the tool.

Locating points, in general, should be placed as far apart as possible; and when there are a number of operations to be performed on the same piece, it is good practice to locate from the same points for as many of the operations as possible.

The order of checking the dimensions as given here will be found a good one to follow. In checking the important dimensions first, any errors found usually affect the accuracy of numerous other minor dimensions; whereas if the minor dimensions were checked first, it is probable that the entire tool would be checked before the error was found. The other items are self-explanatory.

Machine for Cutting Wire into Short Lengths

By FRANK V. KEIP, Adrian, Mich.

Short pieces of flat braided copper wire termed "pig-tails" are used to connect the field coil wires to commutator brushes in electric motors. To cut these off to a uniform length rapidly, the writer designed the machine to be described. A top view of this machine is shown in Fig. 1; at the left may be seen a spool of the flat wire, which is mounted on two bearings extending from the end of the machine. One end of the wire is shown passing through a guide *A* and between two rolls, one of which is shown at *D*.

These rolls rotate continuously, but are separated at regular intervals to discontinue the feeding of the wire while the pieces, one of which is indicated at *F*, are being cut off by the shear knife *E*. The shear knife is operated through a train of gears, and is timed to descend when the two feed-rolls separate. Both the shear knife and the rolls are driven by means of the grooved pulley *G* through a train of spur and bevel gears. Referring to Fig. 2, it will be seen that the shear knife is operated by a crank.

In the diagrammatic view, Fig. 3, the action of the cams that separate the feed-rolls is shown. Here it will be seen that the upper roll *R* is knurled at the center, and this knurled section engages a groove cut in the lower roll. The lower roll guides the wire as it passes through, while the knurl on the upper roll insures a positive feed.

It will be noted that the lower roll is quite long and extends far enough on both sides to enable cams *T* and *U* to rest on it near its ends. These cams are so designed that their contact with the lower roll governs the length of the wire to be cut off. That is, by rotating one of the cams on the shaft the required amount and securing it by means

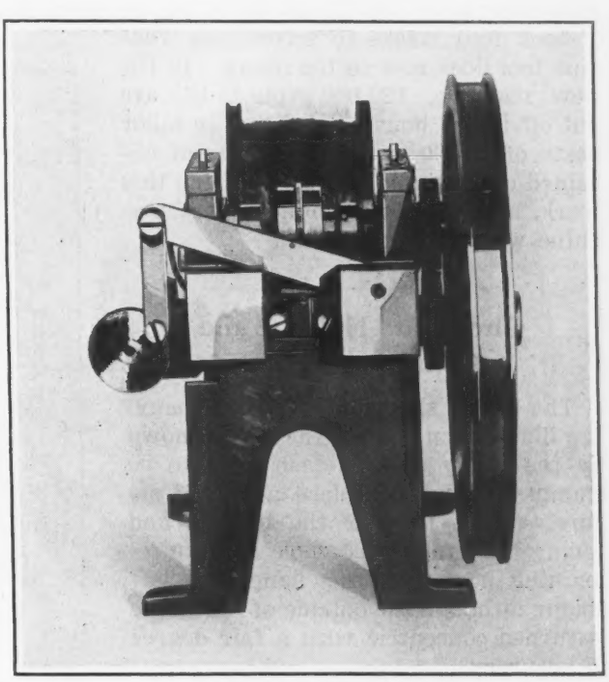


Fig. 2. End View of Machine for Cutting off Wire, Showing Shear Knife

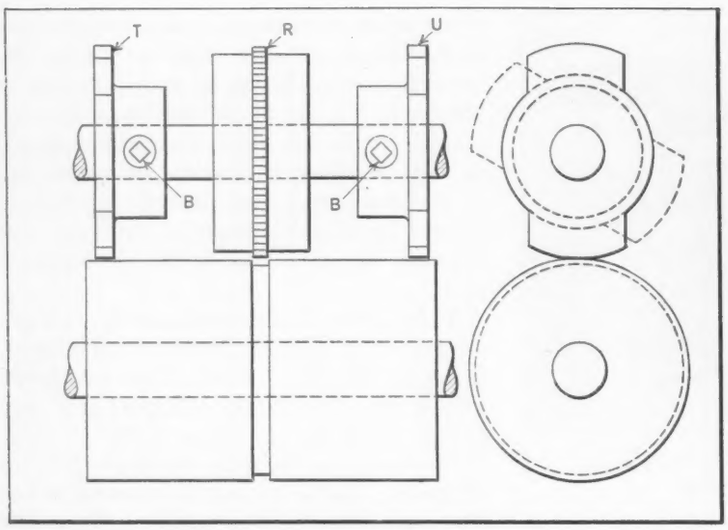


Fig. 3. Diagrammatic View Showing Action of Cams in Machine Illustrated in Figs. 1 and 2

of one of the set-screws *B*, the time that the rolls are separated during each revolution can be increased or decreased. For every revolution of the rolls, two wires are cut. Hence, the bevel gear on the crankshaft driving the shear knife is half the size of the gear secured to the lower roll shaft.

Springs are provided in the housings of the roll shafts to keep the rolls together during the feeding of the wire. In order that there will be no variation in the lengths cut off, a spring *C* (Fig. 1) located at the rear of the rolls bears upon the wire and prevents it from being carried beyond the specified point. Pressure of the spring may be varied by means of a set-screw *B* which raises or lowers it from the wire.

Before the installation of this machine, three girls were kept steadily employed on this work, and it took four weeks to accomplish what this tool does now in ten hours. In the new machine, 120,000 "pig-tails" are cut off in ten hours. A saving in labor costs of $2160 per year has been obtained over the old method of doing this work, and the cost of building the machine was less than $200.

Chuck for Holding and Centering Sleeve

The chuck shown in the accompanying illustration enables the sleeve shown by the heavy dot-and-dash lines to be clamped quickly in place and held securely while turning the outside and facing the flange. The hole and the remaining portion of the flange are left rough, although the outside of the sleeve is turned concentric with a fair degree of accuracy.

The flange is gripped by the jaws *C* of the three-jaw chuck, which centers the rough hole with the lathe spindle, while the outer end, which is a considerable distance from the chuck, is centered and held by means of a cone *A*. The cone slips over arbor *D*, which is held concentric in a bushing *E* in the chuck, the flange *F* preventing the arbor from being pulled out by the wedging action of the cone.

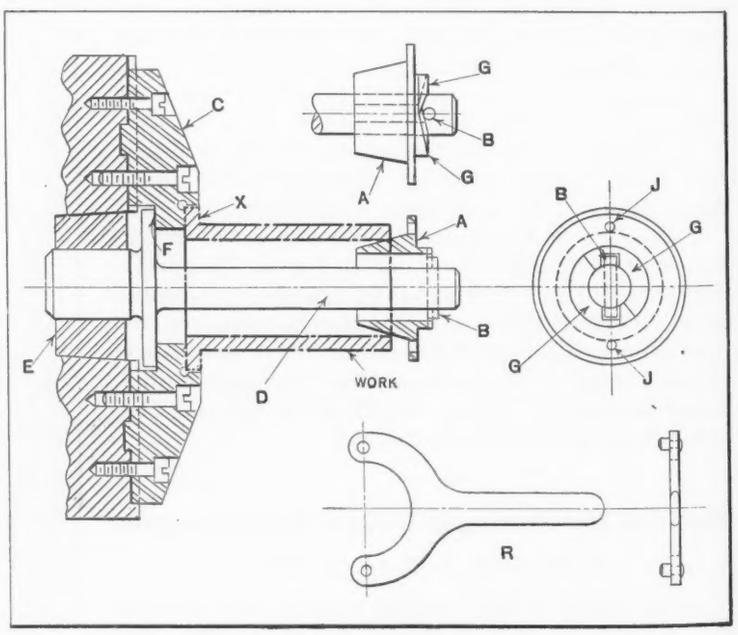
Cone *A* has two grooves on opposite sides of the central hole that clear the ends of the pin *B* which project through the arbor at both sides. These grooves permit the cone to be slipped over the pin ends and secured by turning the cone with the wrench *R*. This causes the spiral cam surfaces *G* to act against the pin *B* and force the cone into the end of the work. The work is thus centralized and adequately supported at the outer end.

To remove a finished piece, cone *A* is loosened by giving it a partial turn with wrench *R*, after which the cone is slipped off arbor *D*. The chuck jaws are then released and the work slipped off over the end of the arbor. To clamp the work, the jaws are first tightened so that they just grip the flange. The cone is then slipped on and turned until it is jammed into the end of the work, after which the jaws are securely tightened. The holes *J* in part *A* fit the pins in wrench *R*. H. M.

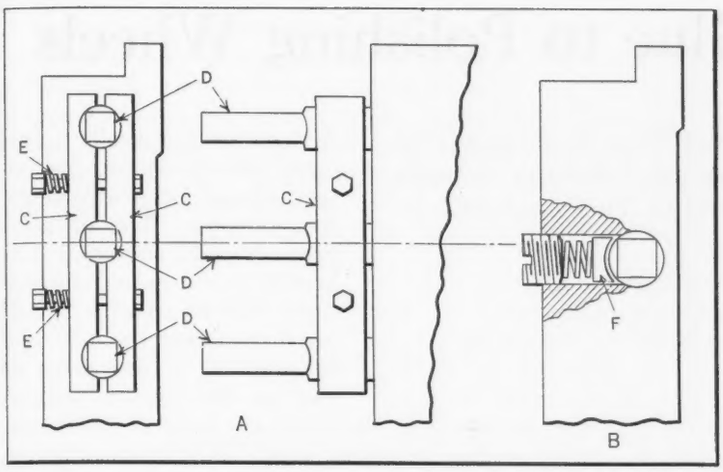
Brake-Shoe for Planer Feed-Screw

By JOHN A. COOK, Birmingham, Ala.

The feed-screws of an old planer that turned very freely in their worn bearings developed the troublesome habit of rocking back and forth with



Chuck for Centering and Holding Sleeve



Methods of Applying Brake to Feed-screws that have Tendency to Rock Back and Forth with Ratchet Lever

the ratchet lever, causing the feed to operate intermittently or not at all. To remedy this trouble, the writer applied brake-shoes to the feed-screws, as shown in the accompanying illustration at *A*. The brake-shoes *C* are made of fiber and fitted to the feed-screws *D*. The helical compression springs *E* provide the necessary braking pressure.

At *B* is shown the method used in applying a braking pressure to the feed-screw of an old shaper that developed similar trouble. The brake-shoe *F* used in this arrangement was also made of fiber.

Shaving Tool for Automatic Screw Machine

By HAROLD P. BERRY, Camden, N. J.

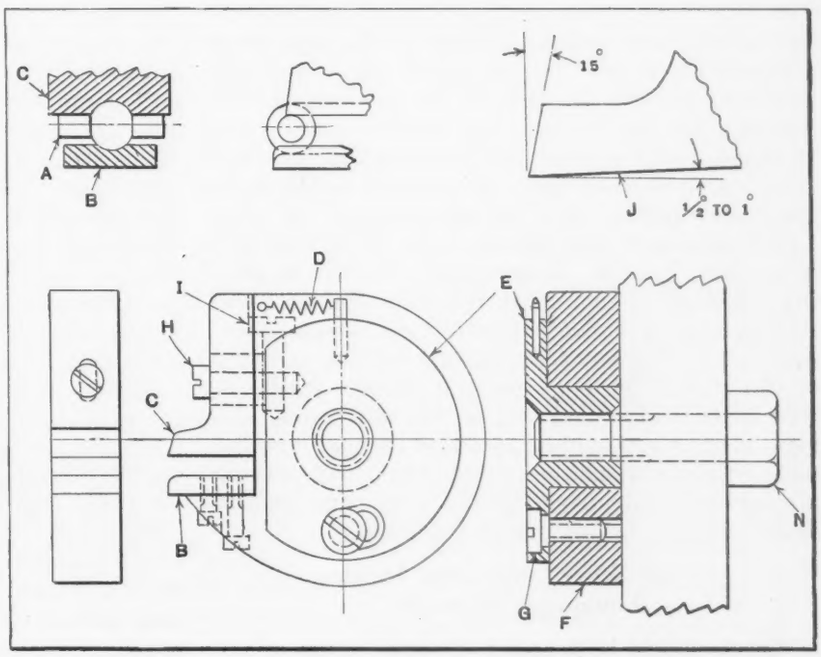
The fixture shown in the illustration will be found to be very efficient in finishing the class of work indicated at *A* on a B & S automatic screw machine. Here is a condition in which a ball with a shank on each side is required to be held within close limits and all diameters must be concentric. The success of the operation depends on the fixture being permitted to swing freely, so that the cutting tool can follow the slightest eccentricity of the work.

The fixture is mounted on the front cross-slide of the machine and clamped in place against the regular circular form tool-holder by means of the cap-screw *N* in the retainer *E*. On the hub of this retainer is the rotary member *F* to which is clamped the shaving cutter *C* and the work guide *B*. The movement of member *F* is limited by the shoulder screw *G*, which engages an elongated slot in the retainer so that the work will be able to pass between the guide *B* and the cutter properly.

The shaving tool is clamped in position on member *F* by the screw *H*. Close adjustment of the cutter is made by the aid of the shoulder screw *I*. A close fitting tongue and groove on the shaving tool and on member *F* insures the proper vertical position of the cutter. The rake on the cutting edge of the cutter should be about 15 degrees for cold-rolled steel, and a clearance angle should be provided to prevent the cutter from dragging on the work after the shaving operation. The clearance angle, as illustrated in the enlarged view *J*, varies from 1/2 to 1 degree, and should be determined by experiment, as it will differ according to the materials to be machined.

All wearing parts should be hardened to reduce friction and insure free movement. The latter condition also depends on the tension of spring *D*, which is determined by experiment. The cutting edge of the tool *C* should be stoned with a fine oilstone occasionally to eliminate the forming lines or tool marks on the work caused by a wire-edged cutting tool.

The results obtained with this type of tool depend considerably upon the preliminary operations performed on the work and the condition of the cutting edges on the tools with which it was machined. The work should be left as smooth as possible, so that the shaving tool will not be required to remove more than a few thousandths of an inch, as the smaller the amount removed, the smoother the finish obtained. It will be necessary in some cases to make use of a rest held in the turret, and to back up the work while performing the shaving operation in order to prevent it from springing while the shaving tool is cutting.



Shaving Tool for Screw Machine, in which the Cutter has a Floating Action

How to Apply Glue to Polishing Wheels

Factors that Must be Considered in Setting up Polishing Wheels Second of Two Articles

By ROBERT T. KENT
Director of Engineering
Divine Bros. Co., Utica, N. Y.

GLUE deteriorates in strength when subjected to heat for any length of time, about 65 per cent of its strength being lost at the end of twelve hours. The rate of deterioration is, roughly, 5 per cent for every hour it is kept under heat. Thus the last glue from a batch made up to meet the needs of a four-hour period will have lost an appreciable amount of strength. This indicates the advantage of small glue pots and frequent preparation of small batches of glue, as described in the first article on page 672, of May MACHINERY.

Why Glue Should be Used as Soon as Prepared

Glue is impregnated with bacteria which thrive on heat and in dirt. Hence the necessity of keeping all utensils and apparatus used in the glue room scrupulously clean. The mixing of old, cooked glue with new batches should also be avoided. In the old glue, bacterial action has already started, and if mixed with the new uncooked glue, bacteria will form much more quickly than would normally be the case, causing rapid deterioration of the glue.

The statement has already been made that glue is sensitive to heat. It is equally sensitive to chilling. A draft of cool air striking hot glue or a cool surface coming in contact with it will shock it, and cause an initial set, reducing the holding strength of the glue. The glue room, therefore, should be free from drafts, and yet, at the same time, well ventilated. Air should be admitted through louvres, and deflectors should be provided that will prevent air currents from striking the glue pots, wheels, grain troughs, or setting-up machines.

Proper Wheel and Grain Heating Equipment Necessary

Wheels should be heated to a temperature of 110 to 120 degrees F. before the glue is applied to them. A steam or electrically heated oven, with thermostatic control, should be provided for this purpose. The abrasive grain troughs should also be heated to the same temperature. These troughs should be so built that the heat will be applied to the sides as well as the bottom. Otherwise, the grain at the bottom will be hot and that on the surface relatively cool. The correct arrangement of a trough for heating the abrasive grain is shown in Fig. 1. Setting-up machines for putting the abrasive surface on a polishing wheel automatically heat the grain as it is applied. In Fig. 2 is shown a Scovill wheel-heading machine for putting abrasive grain on wheels.

The effect of all the foregoing precautions will be completely nullified if the wheels are dried for too short a time, at too high a temperature, or in a relatively moist atmosphere. The action of glue in drying is comparable to that of concrete. Both glue and concrete apparently dry in a comparatively short time. After drying, however, both materials pass through the stage known as "setting," for which a certain time must be allowed. Although a concrete wall or foundation will be apparently dry and hard in a few hours after pouring, it would be extremely unsafe to subject either to a load for several days. Glue also goes through a like period of setting.

After the surface is dry, the glue requires time to set in order to develop its maximum strength. The time necessary is forty-eight hours. After that, further drying will not develop any additional strength, but less time will shorten the life of the wheel-head. Attempts to accelerate the setting by the application of heat will defeat the purpose. Heat will only promote bacterial action in the glue and destroy its strength. The best results will be obtained when the wheels are allowed to set at room temperature (72 degrees F.).

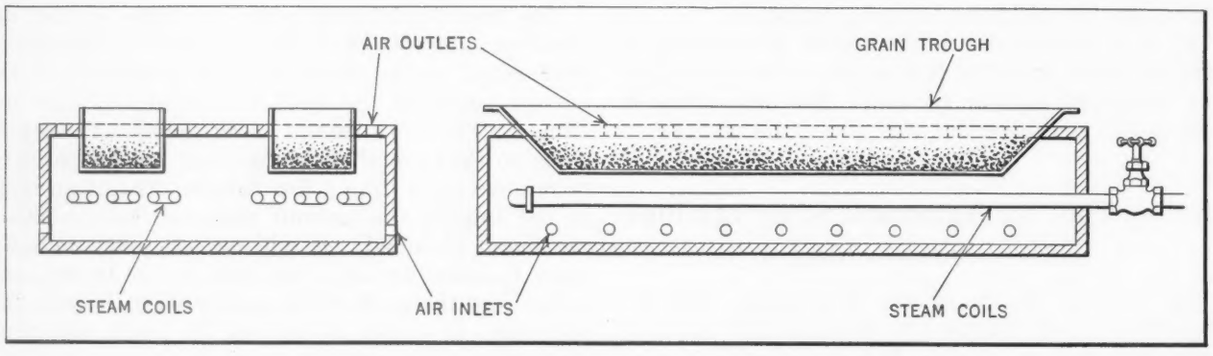


Fig. 1. Correct Arrangement of Trough for Heating Abrasive Grain

The objection might be raised that to allow a forty-eight-hour setting period, as compared with a twenty-four-hour period, would require double the number of wheels, and the increase in inventory would not be justified. It should be remembered that if the life of the wheel-head is doubled, the number of wheels required would be halved. The objection to the forty-eight-hour period therefore disappears.

Effect of Humidity

While the variables entering into the preparation of a polishing wheel, which have been considered in the foregoing, could all be controlled, it has been impossible, until recently, to control the condition of the atmosphere, which is a very important factor. Excessive humidity in the air prevents wheels from setting properly, and as a result, the life of the wheel-heads could not be kept uniform. Sometimes wheels would fail to cut efficiently, and in the hot, humid days of midsummer would fail to set at all. It has not been uncommon to have polishing rooms shut down for weeks at a time, because the wheels could not be made to set on account of excessive humidity in the atmosphere.

Another irritating feature of the effect of excessive humidity has been the instability of piece rates in the polishing room. Owing to the ineffective wheel-heads in humid weather, polishers could not make a fair day's pay, and frequently would demand revised piece rates. Upon the return of better weather, the daily earnings would mount to unhealthy proportions, and any attempt to revise piece rates downward frequently would lead to trouble. The importance of humidity control from this one standpoint alone is obvious.

Air conditioning is not new. It has long been an accepted fact that any desired degree of humidity could be obtained and maintained. The apparatus, however, was expensive and not built for small installations. Only the larger polishing plants could afford humidity control, and few of these recognized its importance. Within the last year, however, the small type of humidity control apparatus, shown in Fig. 3, which is especially adapted to glue rooms, has been developed. With this apparatus available, the last obstacle to complete control of the condition of the polishing wheel when it goes to the workman has been removed. It is now possible to set a definite standard for a polishing-wheel head, and to set up conditions that will insure that standard being attained.

With complete control of the character of the glue, of the methods of preparing and applying it, and of the conditions under which it will set, it should be an easy matter to double or even triple the life of the wheel-head in the average polishing room. As pointed out earlier, this will effect material economies throughout the entire department. The savings so made will pay for the necessary expenditure in a very short time.

* * *

Of the 4,040,000 cars and trucks built throughout the world in 1930, 3,500,000 were built in the United States and Canada, 220,000 in France, 170,000 in England, 66,500 in Germany, 43,600 in Italy, with the remainder scattered between eleven other countries.

Fig. 3. Humidity Control Unit for Polishing-wheel Glue Room

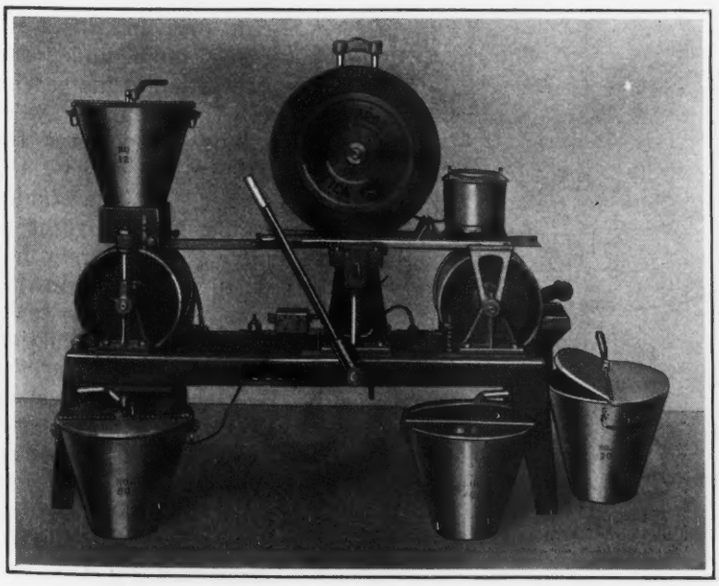


Fig. 2. Wheel-heading Machine for Putting Abrasive Surface on Polishing Wheel

Questions and Answers

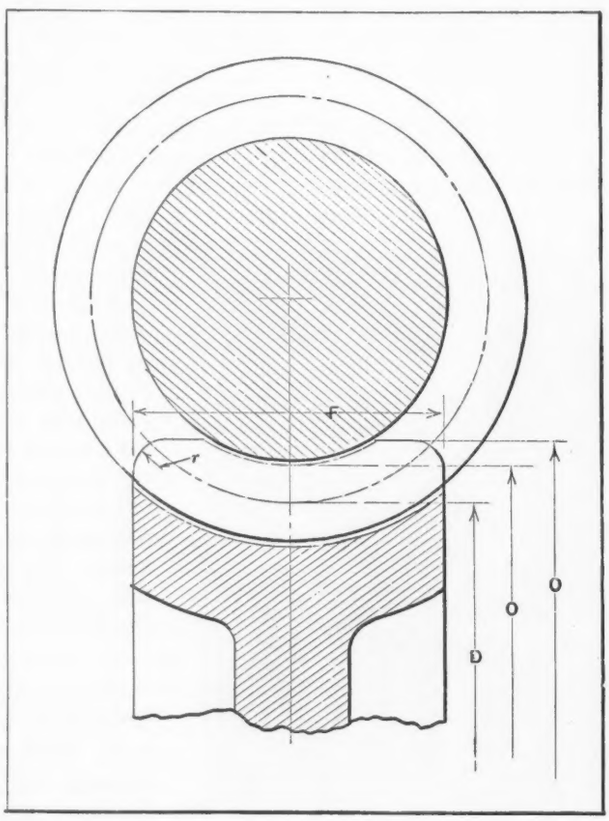
A Department in which the Readers of MACHINERY are Given an Opportunity to Exchange Information on Questions Pertaining to the Machine Industries

A. L.—A great many worm-wheels have beveled rims, and this is the form illustrated in most text-books on gearing, but modern worm-gearing designed primarily for power transmission, as in rear axle truck drives, speed-reducing units, etc., does not have this beveled form of wheel rim. Why has the shape been changed and what form is recommended?

A.—Although many classes of worm-gearing have the beveled or chamfered style of wheel rim, this is not employed for worm-gearing designed for power transmission because it reduces the tooth contact and involves unnecessary machining. The cross-sectional shape of the rim commonly used in modern worm-gearing is shown by the accompanying diagram, and it will be seen that this rim is practically square, except that the corners are rounded somewhat. The radius r of this rounded edge, according to the recommended practice of the American Gear Manufacturers' Association, equals one-fourth the pitch of the worm (or circular pitch of the wheel). In the formulas that follow,

F = face width (see accompanying illustration);
P = pitch of worm and circular pitch of worm-gear;
D = pitch diameter of worm-gear;
O = throat diameter of worm-gear;
O' = outside diameter of worm-gear;
S = addendum or height of worm tooth above pitch line;
d = pitch diameter of worm;
N = number of teeth in worm-gear;
r = corner radius.

According to the recommended practice of the American Gear Manufacturers' Association, $F = 2.38 \times P + 0.25$ for worm-gears used with single- and double-thread worms. For triple- and quadruple-thread worms, $F = 2.15 \times P + 0.2$.



Shape of Worm-gear Rim Now Commonly Used in Preference to Beveled Form

According to David Brown & Sons, Ltd., well-known English manufacturers of worm-gearing: $F = 2\sqrt{S^2 + Sd}$ (the face width should not exceed this value). $O' = D + 3S$. For a full-depth tooth, $S = 0.3183 \times P$. If the helix angle of the worm thread exceeds 20 degrees, $S = 0.3183 \times P_n$, in which $P_n = P \times$ cosine helix angle. The throat diameter $O = D + 2S$ and $D = \frac{NP}{3.1416}$.

According to the recommended practice of the American Gear Manufacturers' Association, $O' = O + (0.4775 \times P)$ for single- and double-thread worms, and for triple- and quadruple-thread worms, $O' = O + (0.3183 \times P)$.

T. Y.—A certain company purchased a patented boiler. After several years' use, the boiler required extensive repairs. An engineering company contracted to do this work, which amounted to a reconstruction of the boiler and replacement of its tubes, the arrangement of the latter within the shell being a vital element of the patent covering the boiler. Can the engineering company do this work without being accused of infringement of the patent?

A.—It is probable that the owner of the patent can prevent the work being done under the protection of his patent. If the repairs were minor, or perhaps for an emergency, the owner of the boiler would have a right to have them done; but when repairs, as in this case, amount to substantial reconstruction or reproduction of the original, it seems clear that the contemplated work by the engineering company would amount to infringement of the patent. (138 F. 68)—*Answered by Leslie Childs, Attorney at Law, Indianapolis, Ind.*

Simple Methods for Inspecting Spring Steel

Applying Hardness Tests to Hardened and Tempered Spring Steel Specimens in Order to Determine the Strength and Quality of Purchased Stock

By H. J. MALAFEY
H. F. Livermore Co., Allston, Mass.

MANY small plants engaged in the manufacture of high-quality products cannot afford to maintain the services of a metallurgist or equip a testing laboratory; yet it is important that they keep proper control over the quality of their purchased stock. At comparatively little expense, such plants can obtain a great deal of useful information regarding the materials purchased by making simple hardness, quenching, and micro-etch tests. A hardness testing machine and a small tool-hardening furnace under pyrometer control is practically all the equipment needed.

Hardness tests provide a means for checking the uniformity and quality of the materials, as well as the effects produced by heat-treatment. Knowing that definite relations exist between the Brinell hardness, tensile strength, and fatigue strength, it is possible, by the aid of various formulas and tables such as published by the Society of Automotive Engineers and the American Society for Steel Treating, to obtain a close estimate of the ultimate strength of specimens taken from stock. The writer has found the Rockwell hardness tester to be well adapted for making the required hardness tests, and the data contained in the "Rockwell Tester Direction Book" is convenient for changing Rockwell to Brinell hardness values. Numerous catalogues and data sheets issued by steel manufacturers, as well as articles in technical magazines, also contain considerable information that will help the small manufacturer to maintain control over the quality of the materials purchased.

The method developed and used by the writer for inspecting spring steel in both the rolled and finished condition will serve as a practical example of the procedure. In this example, the spring steel under consideration has a carbon content of 0.70 to 0.80 per cent, and a manganese content of from 0.30 to 0.50 per cent. It is obtained in widths varying from 1/8 to 1 1/2 inches, and in thicknesses of from 0.032 to 0.125 inch. The equipment employed for testing consists of a tool-hardening furnace with a pyrometer, a Rockwell hardness tester, and the accompanying table containing the Rockwell hardness readings corresponding to different tempering temperatures.

The data in the accompanying table is taken from specimens that were oil-quenched at 1460 degrees F., and held at both the hardening and tempering temperatures for ten minutes. The hardness readings are the average of three specimens for each temperature, with four to five readings per specimen. The specimens are placed on the platform in the furnace, within 1/2 inch of the thermo-couple elements of the pyrometer.

The spring steel in the cold-rolled condition is inspected in the following manner: A sample section about 3 inches long is cut from the purchased material and heated to the proper hardening temperature—usually 1460 degrees F.—after which it is quenched in oil. From five to ten minutes is allowed for heating at the required temperature for all sections 1/8 inch thick or under. After being quenched, a small piece is broken off the specimen and examined visually for grain refinement. The remaining portion is rough-polished and tested for hardness with the Rockwell hardness tester. The same specimen is then reheated and quenched twice,

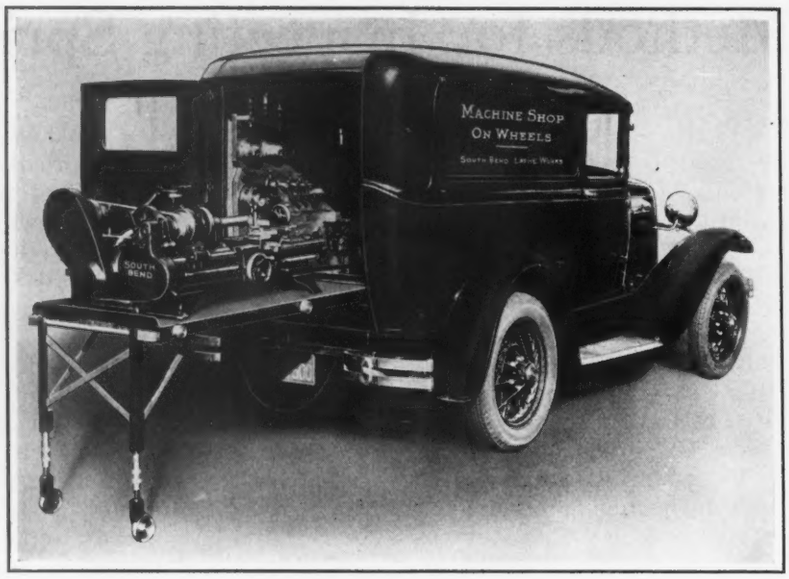
Effect of Heat-treatment on Hardness of Spring Steel*

Tempering Temperatures, Degrees F.	Rockwell Hardness Readings, "C" Scale — Thickness of Specimens, Inches			Tempering Temperatures, Degrees F.	Rockwell Hardness Readings, "C" Scale — Thickness of Specimens, Inches		
	0.047	0.092	0.125		0.047	0.092	0.125
As quenched	67.5	66.5	65.0	775	51.0	....	....
350	66.0	65.0	65.0	800	50.0	48.5	47.5
400	65.0	64.0	63.0	825	49.0	....	....
450	62.5	61.5	61.0	850	48.0	46.0	45.5
500	61.5	60.0	59.5	875	47.5	....	....
550	60.0	59.0	57.0	900	45.0	44.0	43.0
600	58.0	56.5	56.0	950	41.5	42.5	41.5
625	56.5	....	....	1000	39.0	38.5	38.0
650	56.0	55.0	53.5	1050	37.5	36.0	35.5
675	55.0	....	....	1100	31.5	30.5	30.5
700	54.0	52.5	52.0	1150	29.0	29.0	29.0
725	53.0	....	....	1200	26.0	26.0	26.0
750	51.5	50.5	50.0	1250	....	24.0	23.5

*Data in table taken from spring steel specimens having 0.70 to 0.80 per cent carbon and 0.30 to 0.50 per cent manganese. These specimens were quenched in oil at 1460 degrees F., and were held at both the hardening and tempering temperatures for ten minutes.

the hardness being tested after each quenching operation.

If the proper hardness reading is obtained after each quenching, the steel is accepted. Should the specimen fail to come up to standard, a chemical analysis and microscopic examination is made. Acceptance of the material then depends on the reports obtained from this analysis and examination.



A Motor Truck with Bench Lathe Conveniently Arranged for Use in the Field

The material of finished products purchased from other concerns is tested in the same way as the raw material, with a few exceptions. Primarily, the method is as follows: (1) Test the part for hardness and compare the reading with the standard established for the heat-treatment specified for the part. (2) Fracture a sample or specimen of part and inspect for grain size or refinement. (3) Heat specimen to proper hardening temperature, quench, and make hardness test. (4) Temper to specified temperature, and apply hardness test.

These tests provide a very simple and inexpensive method of inspecting the raw material or the material of a finished part. Knowing the proper quenching temperature, quenching medium, time for holding the required temperature, and maximum hardness for certain classes of steel which have given satisfactory results, it is a simple matter to check new lots of steel against the established standards. In hardening specimens, care should be taken to see that the atmosphere in the heating furnace is not oxidizing, or, in other words, has no decarburizing action on the specimen. Also, it is necessary that the pyrometer equipment give correct temperature readings, and that the specimen be placed close to the thermo-couple.

* * *

A Machine Shop on Wheels

A movable machine shop consisting of a 9-inch bench lathe and attachments, installed in a Ford delivery truck, has recently been developed by experimental engineers of the South Bend Lathe Works, 724 E. Madison St., South Bend, Ind. As will be apparent from the illustration, the lathe is attached to a sliding base which can be withdrawn from the truck so that the lathe can be conveniently used. In the withdrawn position, two adjustable legs support the headstock end of the base. When the lathe is pushed back into the truck, rollers attached to the base run on angle-iron strips in the truck floor.

There are four sources from which power may be obtained for operating such a maintenance unit: First, from commercial electric power available in the vicinity where the equipment is used; second, from a small gasoline engine installed in the truck; third, from the truck drive shaft by transmitting power to a lineshaft and then to the lathe; and fourth, from the truck drive shaft by using it to drive a direct-current dynamo for developing electric power to drive the lathe and other machines that might be installed in the truck.

* * *

Moving a Large Machine Shop

By L. G. PATTERSON, Shop Superintendent, Armstrong Machine Works, Three Rivers, Mich.

The article in May MACHINERY entitled "Moving a Large Machine Shop" suggests that some readers may be interested in the moving of our plant some time ago. In the old plant, the regular type of lineshafting was used, but in the new plant new lineshafts and motors were installed for group drives. Several months were spent in planning the new plant and in making blueprints of the lay-out. Then the new shafts and motors were installed and the machines were moved one at a time. Before being moved, each machine was cleaned thoroughly by the operator, who also helped to place it on skids. It was then trucked to the new plant, set up, and repainted with a quick-drying enamel. In this way, the machine was ready to operate the next morning. No machine was out of production more than twenty-four hours.

When the moving was completed, the new plant presented a very pleasing appearance, because all the machines were painted alike.

* * *

The number of cars and trucks registered in the United States in 1930 was 26,523,800. Of these, 3,510,000 were built that year. The wholesale value of the products of the industry was $3,331,000,000.

What We Have Learned About Tungsten Carbide

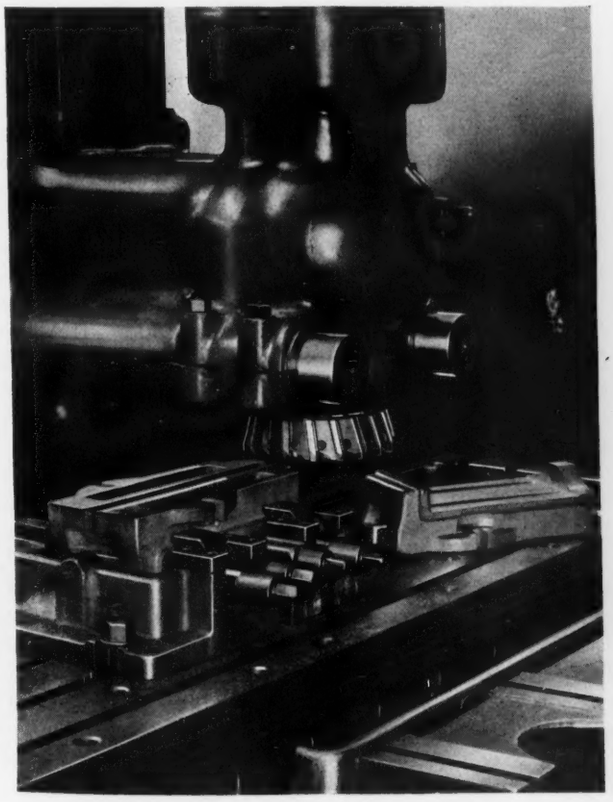
From Our Present Knowledge of This Cutting Alloy Have Been Evolved Ten Fundamental Rules for its Application—First of Two Articles

By FRANK W. CURTIS, Research Engineer
Kearney & Trecker Corporation, Milwaukee, Wis.

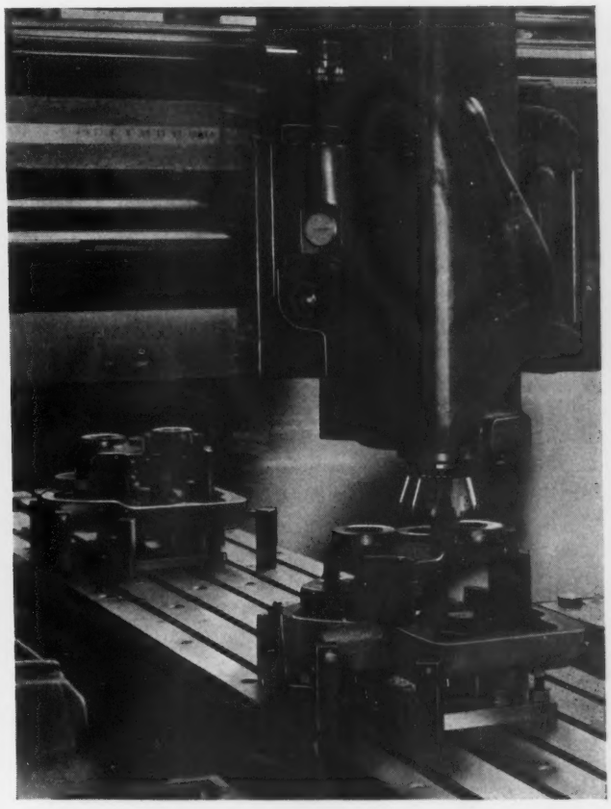
IT is not reasonable to expect the greatest returns from any new development or product unless a certain amount of effort is spent in learning the full possibilities it offers—and usually its limitations. This condition is quite true with cemented tungsten carbide and other hard metal compositions that are gradually being recognized as much needed tools of industry. To apply tungsten-carbide tools economically means that certain procedures must be adhered to; otherwise their full benefits will not be realized.

Tungsten-carbide tools are expensive—comparatively speaking—yet they can be made to earn such large dividends on their investment that they are actually the cheapest in the long run. True enough, the scope of application is limited, but it is reasonable to assume that it will be extended in the future. From our experience and research work conducted with tungsten carbide, we find that the correct application of this cutting alloy depends on the proper consideration of ten important rules which are listed here. They must be followed as carefully as possible if the full benefits are to be realized. They are discussed in the order of their importance, but it will be well to bear in mind that they are all equally essential for the achievement of satisfactory results. The first three considerations, or rules, listed have to do with the nature of the set-up, including the work-piece, the machine, and the jigs or fixtures; the next two with the tool

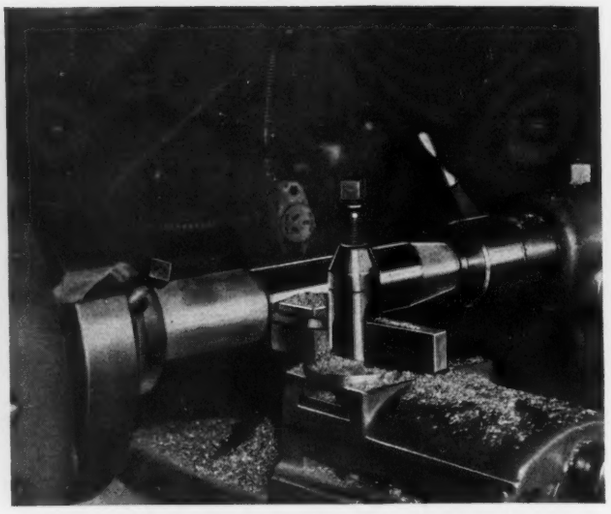
Milling Vise Bodies with Tungsten-carbide Tools, Using Roughing and Finishing Speeds of 275 and 364 Feet per Minute, Respectively, and a Feed of 21 Inches per Minute. Reduction in Machining Time, 70 Per Cent



Milling Four Surfaces at Different Heights within Limits of 0.001 Inch. Cutting Speed, 300 Feet per Minute; Feed, 17 Inches per Minute. One Piece is Loaded while the Other is Being Machined



Facing Semi-steel with Tantalum-carbide Tools. Cutting Speed, 286 Feet per Minute; Feed, 0.015 Inch per Revolution. Roughing Cut, 5/32 Inch Deep; Finishing Cut, 0.005 Inch Deep. Facing Time Reduced 42 Per Cent



Obtaining a Mirror-like Finish on Bronze Elevating Nut at a Speed of 400 Feet per Minute and a Feed of 0.020 Inch per Revolution, Using Tungsten Carbide. Reduction in Machining Time, 44 Per Cent

itself; the following two with operation; the next two with grinding and maintenance; and the last one with economic advantages.

1. Apply only on suitable operations.
2. Use only machines worthy of application.
3. Provide rigidly constructed fixtures.
4. Increase the size of the tool.
5. Support the tool solidly.
6. Use correct feeds and speeds.
7. Do not stop tools in cut.
8. Grind tools accurately and correctly.
9. Resharpen tools regularly.
10. Keep extra tools on hand.

The first five rules will be dealt with in this article, and the remaining five will be considered in the second article. For many reasons tungsten-carbide tools should not be given to the machinist for application without first telling him exactly what they are and how they work. In fact, such a procedure is strongly recommended in order to attain full cooperation. Any wide-awake operator will be interested in your story and undoubtedly will be as interested in the results as you are. Explain to him how tungsten carbide is made, tell him all about its limitations, then warn him of the precautions that must be taken to assure success, and finally have him ask as many questions as he cares to. If this is done, you will have his confidence and a better chance for success.

Operations for which Tungsten Carbide is Suited

It is somewhat difficult at this time to outline what may be termed suitable operations for tungsten-carbide application. Straight cuts are to be preferred, although broken or intermittent cuts can be successfully taken provided the shock on the tool is not too severe. Cast iron, malleable iron, semi-steel, bronze, brass, aluminum, Bakelite, fiber, and hard rubber are representative of the materials now being machined successfully with tungsten carbide. The value of its application to steel is somewhat doubtful, although the newer developments of this alloy are being used successfully for this material. Boring, milling, and turning seem to be the most practical applications, although shaping and planing have proved satisfactory in some cases, providing the cut does not induce a shock too severe for the brittle nature of tungsten carbide.

Suitable Machines are Necessary

Experience has shown that tungsten carbide should be used only in machines of a suitable nature. Old machines, in which the spindle, table, lead-screw, tool-block, or other major units are weak or badly worn, as well as machines that are not rigidly designed, are not satisfactory. This fact should be appreciated before attempts are made to tool up for any given operation. Vibration and chatter are probably the worst evils tungsten carbide has to contend with, and it is natural to assume that any machine with "play" would not be sufficiently rigid to permit correct application.

Newer machines that have been primarily designed for tungsten carbide application are to be preferred, largely because of the economic advantages they offer. Tungsten-carbide tools can be used in existing machines, provided they are in good condition and large enough to permit a worthwhile increase in speeds and feeds. It is so important to have a highly efficient machine that it would be well to consider replacing any machines that are in doubt.

In a great many cases, it will be possible to use existing jigs and fixtures, although there are many

holding devices in use today that are entirely too light for even the correct application of high-speed steel. For this reason, a careful analysis should be made of the existing fixtures, to make sure that they are sufficiently strong to withstand the added strains resulting from the use of increased feeds and speeds.

It is just as important to have a well constructed fixture as it is to have a machine basically designed for tungsten-carbide application. Therefore, this consideration should be observed carefully. The outstanding disadvantage of a poor or weak fixture is the fact that the work-piece might become loose and break or spoil the tungsten-carbide tool used to machine it.

Larger Holders Prolong Life of Tungsten Carbide

Increasing the size of tools having tungsten-carbide tips has been found profitable in practically all applications where this metal is used. As mentioned, vibration is very harmful, and naturally if the tool has any chance to spring or push away from the cut, injury is likely to develop. To be on the safe side, it is much better to increase the size of the tool-holder or cutter body so that a larger shank or blade can be used, even if the cost is high. This will offer increased rigidity, which naturally will result in longer life between grinds.

Tool Requires Proper Support

In addition to increasing the size of the tool, it is essential to provide adequate support directly under the cutting edge, in order to overcome vibration. This is just as important as increasing the size of the tool. Sometimes support can be added without much difficulty, whereas in other cases it may be necessary to design an entirely new type of tool-holder in order to provide adequate strength. Many a tool has broken or cracked at the tip because of insufficient support.

Do Apprentices Who Complete Their Course Follow Their Trade?

By C. J. FREUND, Apprentice Supervisor, The Falk Corporation, Milwaukee, Wis.

MOST employers consider apprentice training largely from their own viewpoint. They are interested in apprenticeship only if they can see advantages in the system for themselves and their organization. That is a perfectly normal attitude and one which has led to the establishment of many excellent apprentice training courses.

Here and there, however, we find manufacturers who look at the problem also from the broad standpoint of the welfare of their own industry group and of American industry as a whole. They are convinced that industry will prosper or suffer according to whether the men working in the industry are of a high or a low caliber.

There are even a few employers to whom apprenticeship means the development of the citizenship of the community. They are interested in their community as citizens and they realize that a prosperous business cannot in the long run survive in a community that is deteriorating. Their interest in apprenticeship is shared by many who are not in any way associated with industry—men who are concerned mainly with the youth of the community and who want to see young men established in an occupation that they can follow as their life work.

Very little is known regarding the percentages of trained apprentices who follow their trade. What little is known is confined to one trade—pattern-making—and one state—Wisconsin. This information has been made available by the Industrial Commission of Wisconsin through the Milwaukee branch of the National Metal Trades Association.

Of the patternmaker apprentices who completed their course in that state between 1915 and 1923, inclusive, 29 per cent have never left the employer with whom they obtained their training; 55 per cent are following their trade in other shops; 10 per cent left the original employer but have returned; and only 6 per cent are no longer engaged in patternmaking. It should be explained that among the 6 per cent who are listed as having left the trade are included those who are owners of pattern shops or who occupy supervisory positions in pattern shops, but who are no longer engaged in the actual work of making patterns.

It is also interesting to note that 39 per cent of all the apprentice graduates in this trade are working in the shops where they were trained.

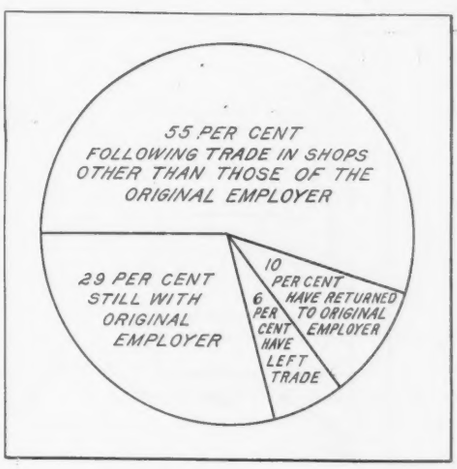

55 PER CENT FOLLOWING TRADE IN SHOPS OTHER THAN THOSE OF THE ORIGINAL EMPLOYER
29 PER CENT STILL WITH ORIGINAL EMPLOYER
10 PER CENT HAVE RETURNED TO ORIGINAL EMPLOYER
6 PER CENT HAVE LEFT TRADE

Diagram Showing that the Great Majority of Apprentices Continue to Follow their Trade

Machining Split Bearing Liners

By CHARLES C. TOMNEY, Chief Tool Designer, Brunswick-Kroeschell Co., New Brunswick, N. J.

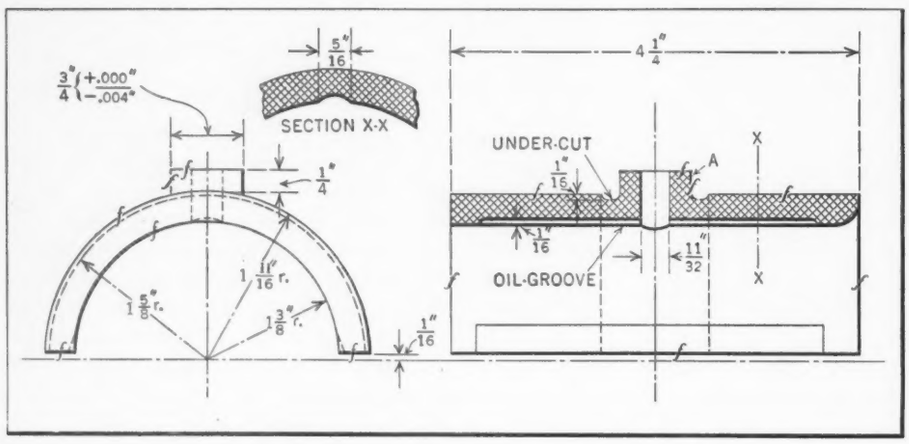


Fig. 1. Upper Half of Main Bearing Liner of Steam Engine

IN Fig. 1 is shown the upper main bearing liner for the 7- by 6-inch vertical steam engine made by the Brunswick-Kroeschell Co. About fifty bearing liners of this kind are used per year. Two of these liners are machined from one casting like the one shown in the upper right-hand corner of Fig. 2. The first operation performed on this casting is that of boring, turning and facing in an engine lathe. The under-cut section in the center of the casting is not machined in this operation and is provided merely to facilitate finishing the pilots or trunnions *A* without doing any hand work. The next operation consists of turning, facing, and drilling the pilots *A*, after which the casting is split into two parts, thus producing two interchangeable liners. The oil-groove indicated in Fig. 1 is cut on a hand milling machine after the splitting operation.

In order to insure a high degree of interchangeability, the combination fixture shown in Figs. 2 and 3 was designed for use in turning the pilots and for splitting the casting into two parts. In Fig. 2 the fixture is shown adapted for use in turning the pilots. The fixture is bolted to the faceplate, being centered by the pilot *B*. The work is placed on the stud *C*, the first pilot or trunnion to be machined being centered as nearly as possible by hand. The work is then clamped in place by means of the nut *D* and washer *E*. After turning, facing, and drilling the pilot, the work is unclamped and turned around one-half revolution, and then positioned for finishing the other pilot.

Accurate location of the work for this operation is obtained by sliding the indexing block *F* forward in the slot *G* until the slot at *H* makes contact with the sides of the finished pilot. As this slot is a close fit over the pilot, it automatically centers the work, so that the two

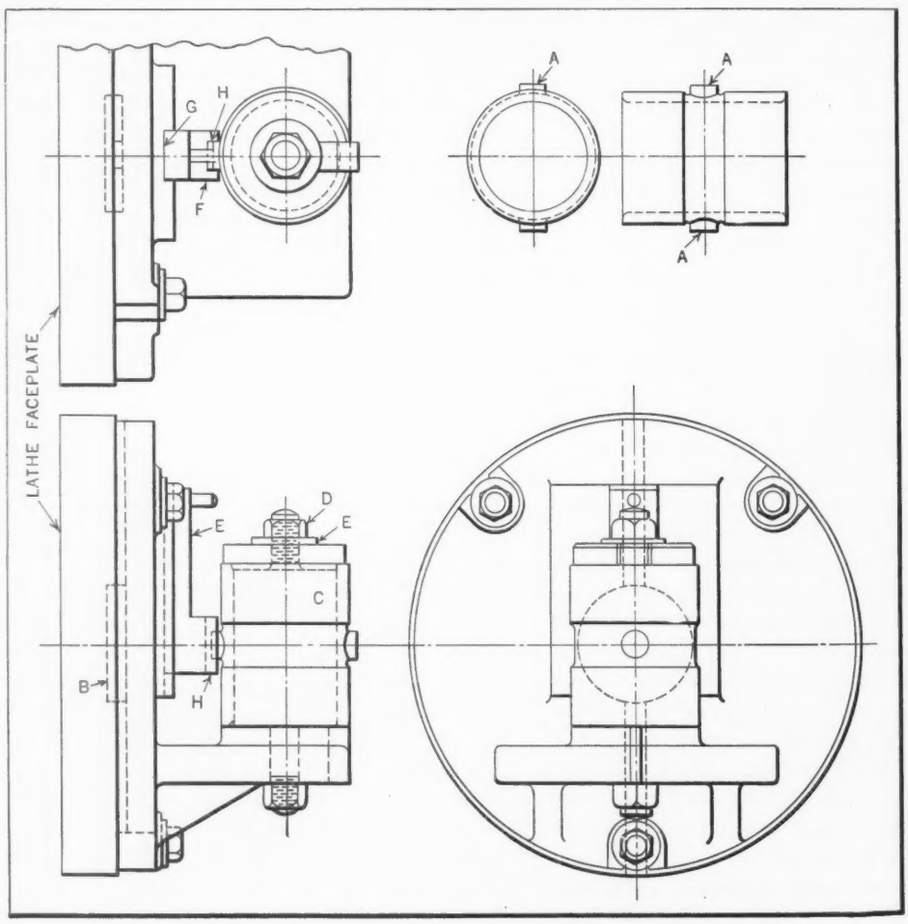


Fig. 2. Fixture Mounted on Lathe for Machining Pilots A

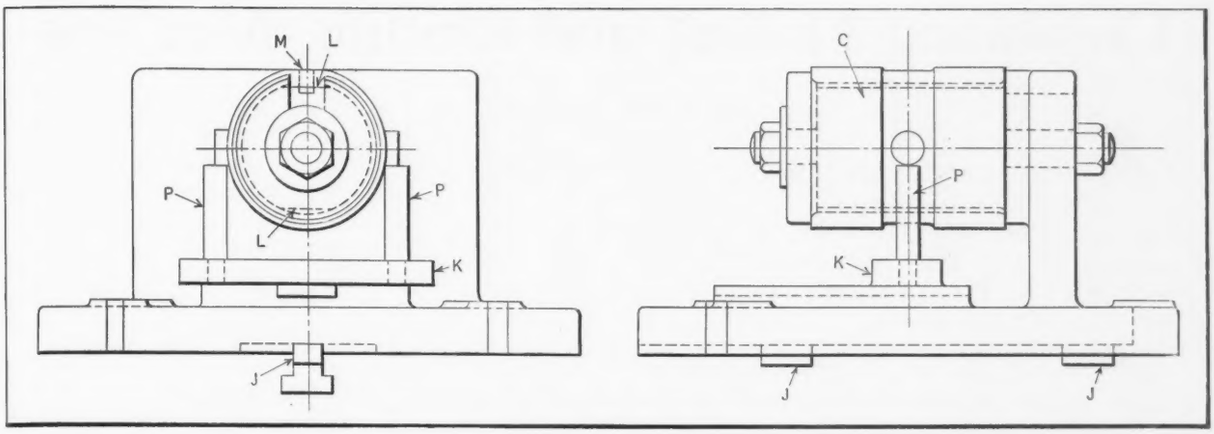


Fig. 3. Fixture Shown in Fig. 2 Equipped for Splitting Bearing Liner Castings

pilots will be diametrically opposite when the turning and facing operations are completed. The indexing block *F* is removed before performing the turning operation, only being used to hold the work in place while tightening the clamping nut *D*.

In Fig. 3 the same fixture is shown equipped for the splitting operation, which separates the casting into two parts. The tongue *J* is a close fit in the T-slot of the milling machine table and serves to align the fixture accurately on the machine table. Bolts are employed to clamp the fixture to the table. For the splitting operation, the work is placed on stud *C* and the pins *P* of the indexing piece *K* are slid under the two pilots while clamping the work.

The stud *C* has two flat surfaces *L* diametrically opposite each other, and the fixture is slotted at *M* to provide clearance for the cutter or saw. The flat surface on the under side of the stud is provided to give sufficient clearance for the burrs produced by the first slotting operation. Thus, it is unnecessary to remove the burrs from the inside of the work before taking the second cut. The saw used for cutting the castings apart is 6 inches in diameter and 1/8 inch wide.

Making Diamond Lapping Paste

By W. E. WARNER

Diamond lapping paste can be made from the old diamonds taken from grinding wheel truing tools. First, a suitable mortar and pestle for pulverizing the diamonds should be made. The mortar may be a piece of steel, 3 inches square, with a 3/4-inch hole drilled and reamed to a depth of 2 inches and finished flat at the bottom. The pestle should also be made of steel and should fit the hole with a clearance of 0.001 inch. Both the mortar and the pestle should be hardened.

Some of the old diamonds which have been removed from their holders should be placed in the mortar and crushed to a powder with the pestle by giving the latter member repeated blows with a hammer. The diamond powder should then be placed in a small receptacle, covered with olive oil, and well stirred. After being allowed to stand for five minutes, the oil should be poured off into another receptacle. The powder that is left in the first receptacle should be labeled powder No. 0.

After allowing the oil to stand for ten minutes in a second receptacle, it is again poured off, leaving a No. 1 powder. The oil is left in the third receptacle thirty minutes, and then is poured off again, leaving a No. 2 powder. No. 3 powder is obtained by allowing the remaining oil to stand for one hour before pouring off. No. 4 powder is obtained by pouring off the oil after allowing it to stand for two hours, while No. 5 powder is had by pouring off the oil after a period of ten hours.

By letting the remaining oil stand until it appears entirely clear, and then pouring it off, a powder designated as No. 6 is obtained. This powder will be found excellent for lapping chromium-plated articles. The seven powders thus obtained have various degrees of fineness which will meet any ordinary lapping requirements.

* * *

In all gray cast iron some free carbon is present in the form of graphite, which has a natural tendency to form large flakes. These flakes produce planes of weakness in the metal and are one of the principal reasons for the low tensile strength of gray cast iron. This weakening effect may be reduced to a minimum by lowering the carbon content as much as practicable and adding alloying elements—nickel or nickel with chromium—to the molten metal to break up the graphite flakes and scatter them throughout the metal. In this way, a tensile strength nearly double that of ordinary cast iron may be obtained.

Combined Milling and Drilling Machine

By ELMER C. COOLEY

IT is frequently possible, when a part requires very light machining operations, to combine several operations. An example of this type of work is shown in Fig. 1. The part illustrated is a cast-iron lever for an electric washing machine, and the operations required are drilling the three 1/8-inch oil-holes *A*, *B*, and *C*, and milling the slot *D*. This slot is milled by sinking a 1/8-inch saw into the boss to the proper depth. In Fig. 3, in the lower left-hand view, the work is shown in the machine in heavy dot-and-dash lines.

It is located in position by two plugs *A* secured in the machine, which pass through the finished bores of the work. The part is clamped in position by means of the strap *C*. The fixture consists chiefly of an angle-iron base, secured to a bench. The drills and the cutter are driven by means of a 1/2-horsepower electric motor through a silent chain passing over the sprocket *Y*.

Provision is made for feeding the three drills and the cutter into the work by means of the hand-lever *D*. This lever is secured to the shaft *E*, which, when oscillated, transmits a straight-line motion to the three drill spindles through the bevel gears *F* and the levers *G*, *H*, *I*, *J*, and *K*.

The lever *K* is pinned to the shaft *L* on which one of the bevel gears *F* is mounted, and transmits the required feeding movement to the angular drill spindle by means of the lever *J* and the link *X*. The angular drill spindle is rotated by means of the shaft A_1, Fig. 3, which transmits motion through a sprocket drive to the sprocket wheel *V* and the bevel gears *W*. This arrangement is shown in the upper left-hand view.

The two horizontal drilling spindles *O* and *P* are rotated by means of the sprocket chain *N* passing over both sprocket wheels on the spindles and a sprocket wheel on the drive shaft A_1. The milling cutter is driven through a train of spur gears which

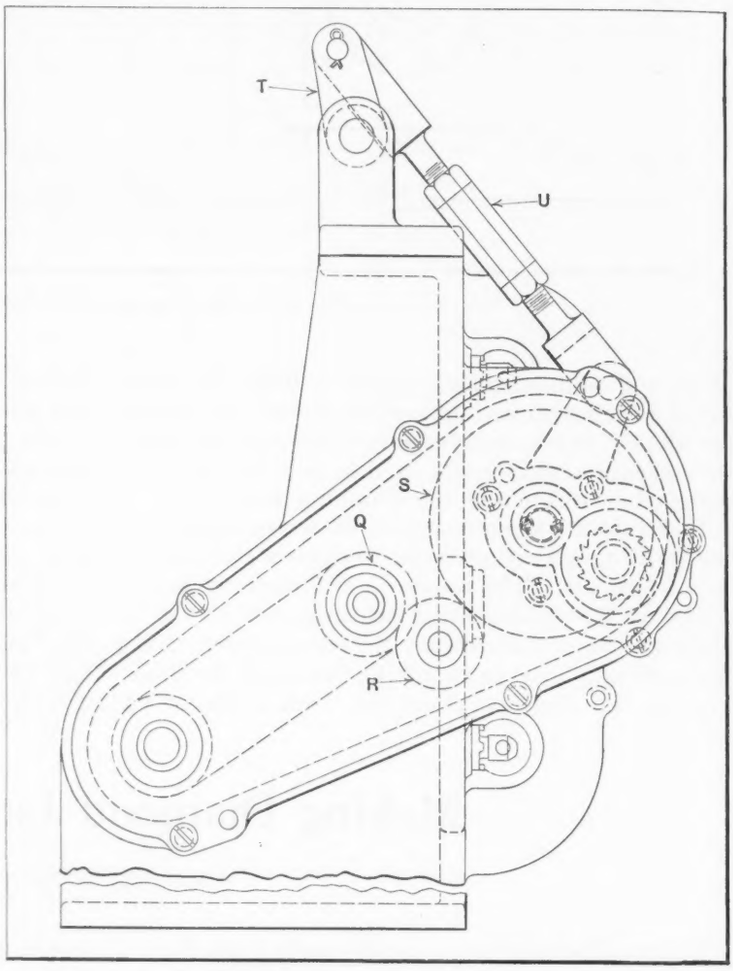


Fig. 2. End View of Machine Illustrated in Fig. 3, Showing the Cutter Driving and Feeding Mechanism

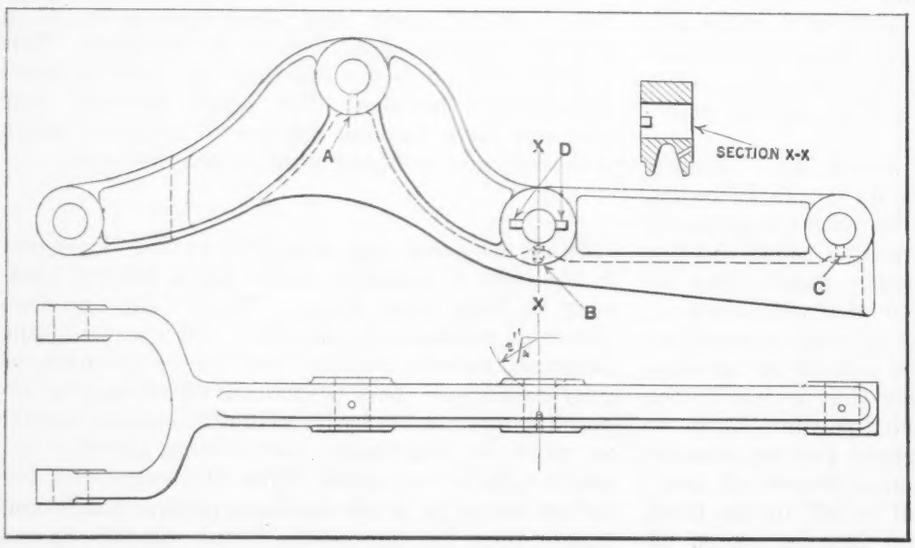


Fig. 1. Electric Washing Machine Arm in which Three Oil-holes are Drilled and a Saw Slot Milled in the Machine Shown in Fig. 3

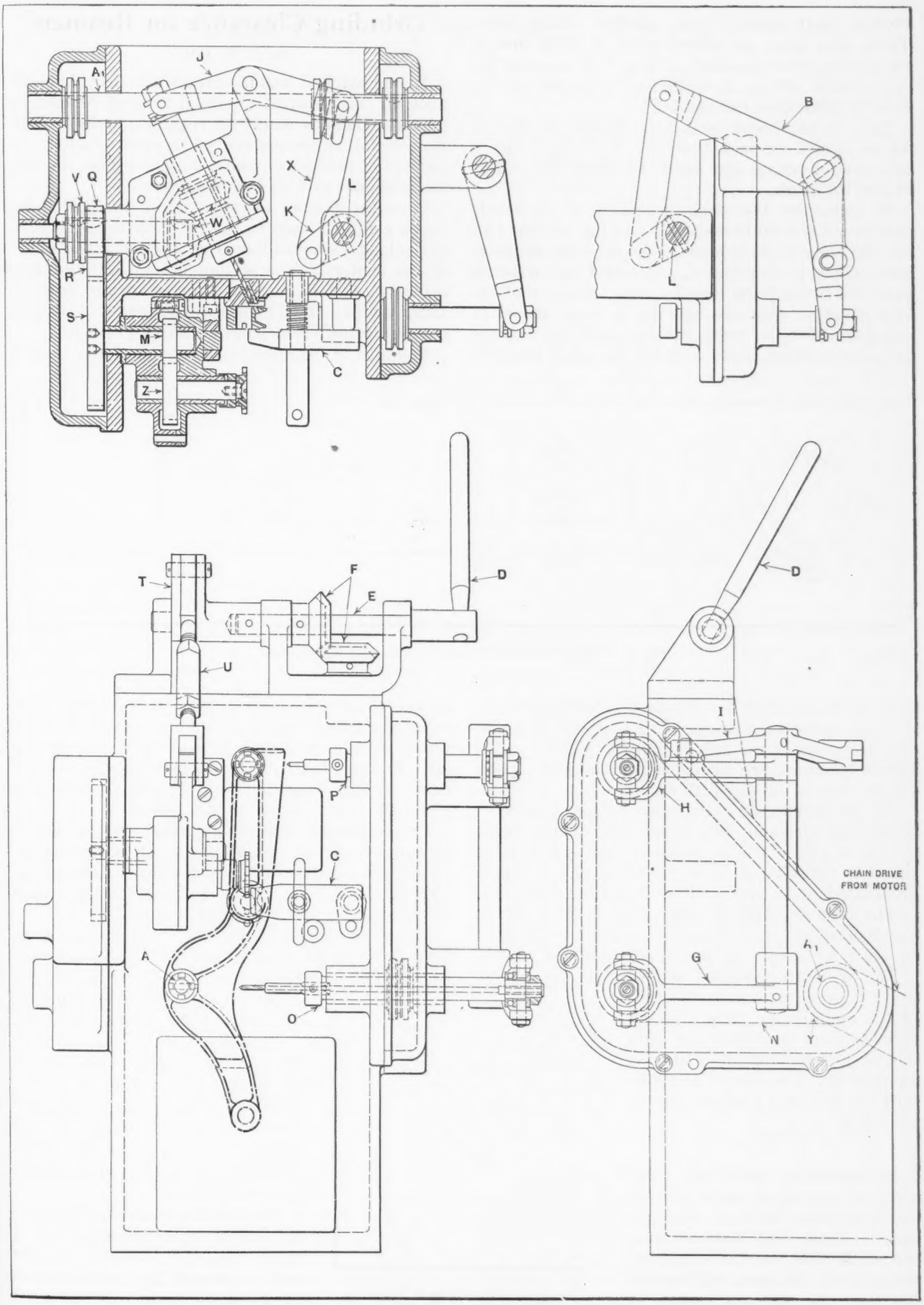


Fig. 3. Details of Machine for Drilling and Milling the Part Shown in Fig. 1

receive their motion from another chain drive. These spur gears are shown at *Q*, *R*, *S*, *M*, and *Z*. On a sleeve over the shaft of gear *S* is mounted the cutter-head, which is oscillated by means of the lever *T*, pinned to the shaft *E*.

This arrangement is clearly shown in Fig. 2, where it will be seen that the nut *U* provides a means of limiting the depth to which the cutter enters the work.

In operation, the work is located as previously mentioned and all three drills and the milling cutter are fed simultaneously to the required depth as lever *D*, Fig. 3, is oscillated, a stop (not shown) being provided to limit the depth of cut. Because of the long distance that the spindle *O* must travel in order to enter the work, special provision is made to have the longitudinal travel of the other two drill spindles begin after the spindle *O* is advanced some distance toward the work. This is effected by slotting the ends of the link *X* and the lever *B*. Ball thrust bearings are provided for the lever yokes on the ends of all the drill spindles.

All the gearing and chains are enclosed, in order to exclude dirt and chips from the working parts. A hole of ample size is drilled through each of the locating plugs *A*, so that the chips can be easily eliminated after each drilling operation. The end of the cutter-spindle is squared off to fit a hole in the special cutter used, and the cutter is fastened in place by means of a countersunk-head screw.

The drills are mounted in slotted sleeves, which, in turn, are secured in the ends of the spindles by means of set-screws, thus providing an easy means of removing the drills for sharpening. The sleeves also support the drill in a position close to the work.

* * *

In threading a stud with a die, the vise jaws often fail to prevent the stud from turning. In such cases, a lathe dog, fastened over the stud, with the tail engaging the sides of the jaws, will usually be found an effective means of overcoming this trouble.

Grinding Clearance on Reamers

By F. W. BACH

In one plant, it was the practice to provide clearance on the flutes of a special type of reamer by grinding them by hand on a regular grinding wheel. However, this method proved so unsatisfactory, on account of the lack of uniformity obtained, that the arbor shown in Fig. 1 was designed.

Here the reamer is shown at *A*, supported between centers *B* and *C*, the center *B* being secured to the long V-shaped bar *D* by a screw. The shank of the center *C* is a sliding fit in the adjustable holder *F*, and it may be clamped in any position along the bar *D* by means of the screw *G*, so that reamers of different lengths can be ground.

Collar *H* is fastened to the shank of the reamer by the three set-screws *I*, and is prevented from rotating relative to the bar *D* by the screw *J*, which passes through the bar and is screwed into the collar. In order to grind the clearance surface on the flutes to the proper contour, it was necessary to offset the center holes in this arbor.

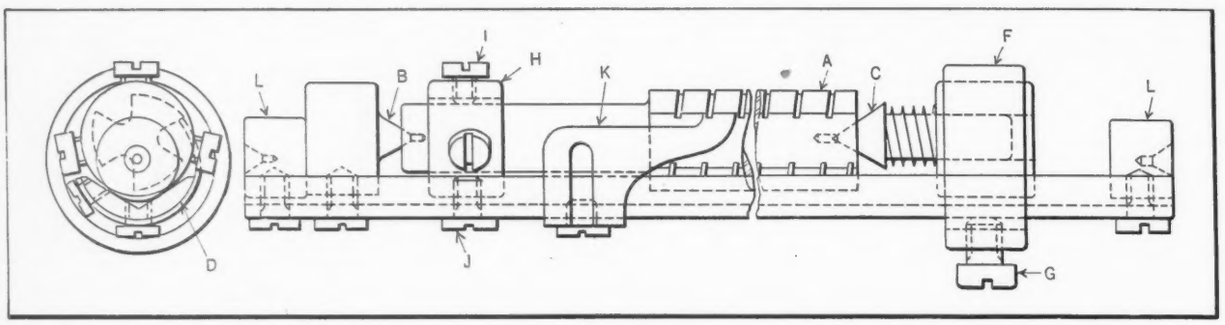


Fig. 1. Offset Arbor for Grinding Clearance on Reamers

By referring to Fig. 2, this offset may be seen to be equal to *X*, so that as the arbor is rotated between the centers on the grinding machine, the edge of the flute at *Y* will be closer to the center of the reamer than the cutting edge *Z*.

A land of about 1/32 inch is left along this edge. Both center holes with which the machine centers engage are located in the disks *L* (Fig. 1), the latter being fastened to the ends of the bar *D* by means of screws.

In order to locate each flute in the correct relation with the offset on the arbor, a finger *K* is provided. This finger can be adjusted until the proper land on the reamer has been procured. Moreover various degrees of clearance can be obtained.

In grinding reamers that have a straight part blending into a taper, the clearance on the straight part is ground first, after which the tailstock is set over to grind the tapered part.

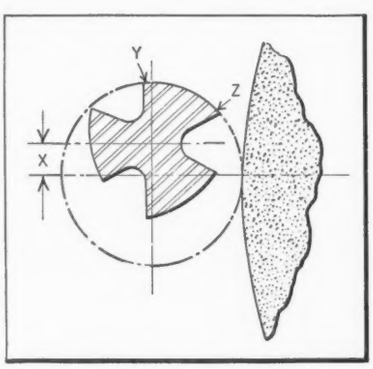


Fig. 2. Cross-section of Reamer, Showing how Clearance is Obtained

Welding Allegheny Metal

Application of Gas and Electric Welding to 18-8 Chrome-Nickel Alloys and General Principles Governing the Procedure

By G. VAN DYKE
Manager, Special Steel Department
Joseph T. Ryerson & Son, Inc., Chicago, Ill.

ALLEGHENY metal is a chrome-nickel iron alloy containing approximately 18 per cent chromium, 8 per cent nickel, and small amounts of manganese and silicon. The carbon in this alloy will vary from 0.15 to 0.06 per cent, depending upon the class of work for which it is to be used and the method employed in fabricating it.

This particular type of alloy lends itself readily to welding by the electric, gas, or spot processes. The "18-8" type of stainless steel finds wide application not only because of its weldability, but also because it presents great resistance to a large variety of corrosive attacks. No material that has so far been produced is really "stainless" in the true sense of the word. Glass, gold, silver, lead, hard rubber, and any other known material can be attacked and corroded by one or more chemical reagents. In determining the value, therefore, of 18-8 or any other corrosion resisting alloys for a certain application, the metal should not be expected to resist all kinds of corrosion, but to be sufficiently resistant for the service required.

The corrosion resistance of an alloy depends on its composition, the care taken in its manufacture, and its structure. The welding of this 18-8 alloy should be done in such a way that neither the analysis nor the structure of the metal will be changed; and for this reason, the chemistry of the flame in gas welding is of vital importance.

Procedure to be Followed in Gas Welding

The first consideration in gas-welding Allegheny metal is to get the proper mixture of acetylene and oxygen. If an excess of oxygen is used, it will burn up or oxidize a considerable portion of the chromium, and this not only changes the analysis of the metal, but also produces oxides of chromium which will cause the metal to boil and result in welds that are porous and of low corrosion resistance value. If an excess of acetylene (which is a compound of hydrogen and carbon) is used, the molten metal will absorb a certain amount of the gas, and the carbon content of the weld will thereby be raised. This increase in carbon content is very detrimental to the corrosion resistance and produces a brittle weld.

Evidently an exactly neutral flame with an excess neither of acetylene nor oxygen would be desirable, and if it were possible to produce such a flame, it would probably be ideal. In actual practice, regulators are not sufficiently accurate to produce a truly neutral flame; therefore, the lesser of two evils must be chosen, and the flame should be adjusted so as to give a very slight excess of acetylene, which is indicated by short "feather tips" on the end of the combustion "buttons."

In gas-welding this alloy, the torch should be held as close to the metal as possible, so as to push the flame down into the weld; and the rod should be held above the weld so that it will melt and drop down as the welding proceeds. Puddling should be avoided, as it tends to produce a porous weld. If the flame is properly adjusted and sufficient heat is used, the Allegheny metal rod will melt freely and will drop down in clean drops.

For those who like to use a flux, a product of the Oxweld Acetylene Co. known as Chromaloy flux is recommended. This has a tendency to make the metal flow a little more freely, and is of assistance in securing deeper penetration.

The use of a tip one or two sizes smaller than would be used on the same gage of steel is recommended, and in most cases, about five pounds pressure on both the acetylene and oxygen will be found sufficient. It is essential that accurate regulators be used, so that a uniform mixture can be maintained continuously.

Methods Employed in Electric Welding

In electric-welding this metal by the metallic arc process, we do not have to concern ourselves with flame chemistry, as in gas welding. It is important, however, that the rod be of the right analysis and that the coating on the rod be of such a character that it will produce sound welds, deep penetration, and a bead of equal corrosion resistance to the parent metal. The production of and coating of the rods is a technical matter which is best left to the manufacturers of the metal.

Reversed polarity should be used, the electrode being connected to the plus pole of the generator, and the work or ground to the negative pole. It is well to use somewhat less power than would be used on a similar gage of steel, although this is a point that is best worked out by each operator. Some men can weld more rapidly than others, and can, therefore, use a greater amount of heat. After a little experience, each operator will find the best voltage and amperage setting for his particular machine on various gages.

A welding outfit with very flexible controls should be provided, because variations in voltage and amperage are likely to have a serious effect on this alloy. A short arc should be used, partly because it will give a more uniform penetration and partly because there is less chance of the molten metal becoming oxidized and thus producing porous welds. Backing up is to be recommended where

possible, and in each case, the operator should be provided with samples on which to experiment for power adjustment and arc length before he starts on any job.

The scale produced on these welds is usually heavy and hard, and it would be very helpful to grind the scale off the bead left by one rod before continuing the weld with the next rod.

General Principles Applying to Welding

There are certain general principles that apply to all types of welding on Allegheny metal. In the first place, when this metal is heated to any temperature in excess of about 500 degrees F., it will discolor or oxidize on the surface. This oxidation must be entirely removed or the metal will rust rapidly. Oxidation can be removed by grinding or by the application of a mixture of one part of commercial nitric acid to one part of commercial hydrochloric acid. This mixture is extremely powerful, and should only be left on the metal for a sufficient length of time (probably a few minutes) to remove the discoloration. It is absolutely essential that every trace of the acid be removed from the metal first by washing with water, and then by a thorough washing with soap and water in which has been dissolved some sal soda, ammonia, or other alkali.

If Allegheny metal is to be used to resist severe corrosive attack, it is essential that it should have the right metallurgical structure. This term means that the carbon should be in solution in the iron and not in the form of carbides, which are chemical combinations of iron and carbon.

It is unfortunately true that metals of the 18-8 type, if heated to temperatures within the range of 550 to 1550 degrees F., will, during certain periods of time, depending on the temperature, undergo a structural change in which some of the carbon will be precipitated from solution and be converted into an iron carbide or perhaps an iron-chromium carbide. These carbides accumulate along the grain boundaries of the metal, and if the metal is then subjected to a strong corrosive agent such as nitric acid, hot salt water, copper sulphate solution, and so forth, an electrolytic effect is developed which will rapidly corrode and destroy the metal.

It is obvious that, in welding, the metal is heated at some point to these temperatures, and therefore there is always an area adjacent to the weld that will have a lower corrosion resistance than the parent metal. This change of precipitation does not occur instantaneously, but requires a certain amount of time to develop. Since a No. 24 gage sheet will cool more rapidly than a 1/4 inch plate, precipitation is less likely to occur in light-gage work than in heavier thicknesses. Experience has indicated that in applications such as soda fountains, restaurant equipment, and so forth, corrosion is of such a mild type that carbide precipitation need not be considered. On the other hand, the calcium bi-sulphide solution used in the sulphite paper industry is so highly corrosive that all welds must be treated to eliminate carbide precipitation. Between these two extremes each application must be considered from the standpoint of the degree of corrosion and the probability of carbide precipitation, which, in turn, is governed by the technique of welding and the thickness of the parts that are welded.

It should be noted that when carbide precipitation has occurred, it can be eliminated by heating the metal to a temperature of about 1950 degrees F., and then cooling it with sufficient rapidity to prevent further precipitation. The method of cooling will, of course, depend on the thickness of the section, and the details of such operations should be discussed with the manufacturers of the metal.

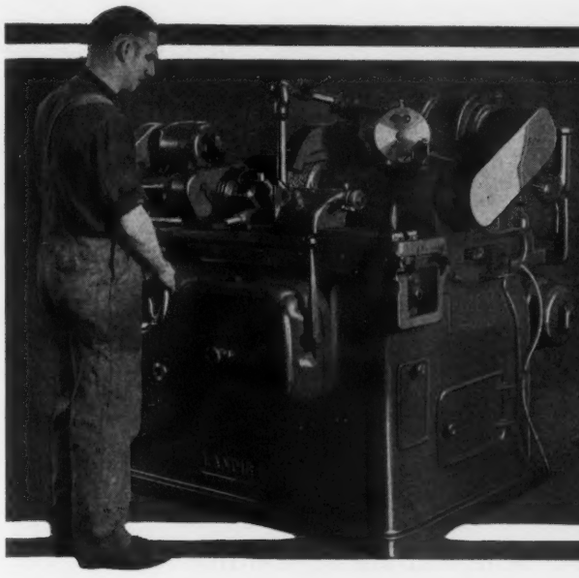
Metals of the 18-8 type will expand, when heated, about 50 per cent more than steel, and the heat conductivity is only about one-half that of steel. These two factors tend to make the metal warp more than steel, and this point must be taken into careful consideration in all welding jobs. Jigs must be used to hold warpage within practical limits. Welds in Allegheny metal are extremely tough, and any welds made on metal of about No. 10 gage or lighter should be able to be bent flat on themselves without fracturing.

There is No Waste

A leading automobile builder installed equipment for salvaging sheet-steel scrap that produced a net return on the investment of 150 per cent in one year. Equipment for handling cast-iron borings and turnings netted 85 per cent on the investment in one year. Equipment for reclaiming oil from steel turnings and borings saved 140,000 gallons of oil in a year, which represented a net return of 18 per cent on the investment. Briquetting and handling equipment for the steel turnings and borings, making it possible to sell them at a higher price than would otherwise have been possible, represented a net return on the investment of 42 per cent. It is worth while looking into what can be done with things around the shop that are usually considered waste. Scrap and chips can be so handled that, practically speaking, "there is no waste." An article in August MACHINERY will give the complete details.

* * *

The increasing use of oil-electric locomotives is indicated by the fact that during the last five years the Ingersoll-Rand Co., in conjunction with the General Electric Co., has furnished nearly one hundred locomotives of this type for service in the United States to railroads, steel mills, and lumber and mining companies. Recently the Bush Terminal Co. decided to place seven of these oil-electric locomotives in service for switching work at the company's Brooklyn terminal. Each of these locomotives is powered by a 300-horsepower railroad-type Diesel engine.



New Shop Equipment

Latest Developments in Machine Tools, Unit Mechanisms, Machine Parts, and Material Handling Appliances

Landis Plain Hydraulic Grinder

A new Type C plain hydraulic grinder has recently been brought out by the Landis Tool Co., Waynesboro, Pa., for such work as universal-joint spiders, small bearings, small motor armatures, and light shafts. This machine incorporates a number of improvements over the previous Type C machine, which was described in MACHINERY, October, 1929, page 99. High production and ease of operation are two of the principal features of the construction. The hydraulic table traverse gives a range of table speeds of from 6 to 240 inches per minute. Other hydraulically controlled movements may be supplied, depending upon the operation. All controls are conveniently grouped.

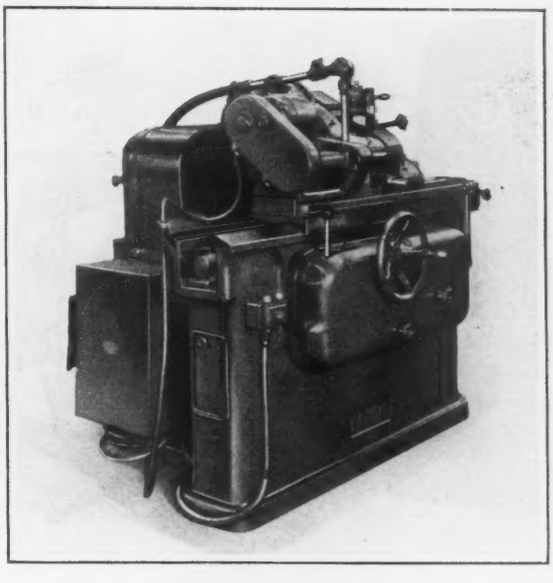
Accessibility of the various mechanisms is another feature of the machine. By removing the large cover at the front of the bed, all control mechanisms are exposed, none of them being entirely within the bed. The complete pump mounting is also readily accessible.

The water reservoir is integral with the bed, while the base forms a reservoir for the oil used by the hydraulic system. The work carriage traverses on a flat guide and a vee having one vertical side. Guideway lubrication of the flooded type is provided, filtered oil being supplied by the same pump that furnishes the pressure for the hydraulic system. Tarrying of the carriage at reversing points is provided for.

Steel-back babbitt bearings are supplied for the grinding-wheel spindle, and these bearings are lubricated continuously. This spindle is driven at the right-hand end through multiple V-belts by a motor mounted on top of the wheel-base casting at the rear. An 18- by 1 1/2- by 8-inch grinding wheel is standard equipment.

The hydraulic system consists of a twin-cylinder table-traversing mechanism and a Tuthill internal-geared oil-pump. Because of the use of twin cylinders, the control valve is made to govern the flow of oil from the end of one cylinder into the corresponding end of the other. Unusual smoothness of operation is claimed for this construction. The oil-pump is mounted at the rear of the bed, and is driven by a constant-speed motor, as is also the water pump. Standard equipment includes a plain wheel-feed mechanism, but a hydraulic automatic wheel feed or a hydraulic straight infeed mechanism can be supplied. The headstock is driven by a constant-speed motor. Four work speeds are available by changing the pulleys and belts at the left-hand end of the head.

This machine is avail-



Landis Hydraulic Grinding Machine with All Control Mechanisms Readily Accessible

able in a 6- by 18-inch size, which weighs 3750 pounds without electrical equipment, and in a 6- by 30-inch size, which weighs 4000 pounds without electrical equipment. A 3-horsepower motor is used for the wheel-spindle drive, a 1-horsepower motor for the pump drive, and a 1/3-horsepower motor for the headstock.

Lapointe Hydraulic Presses

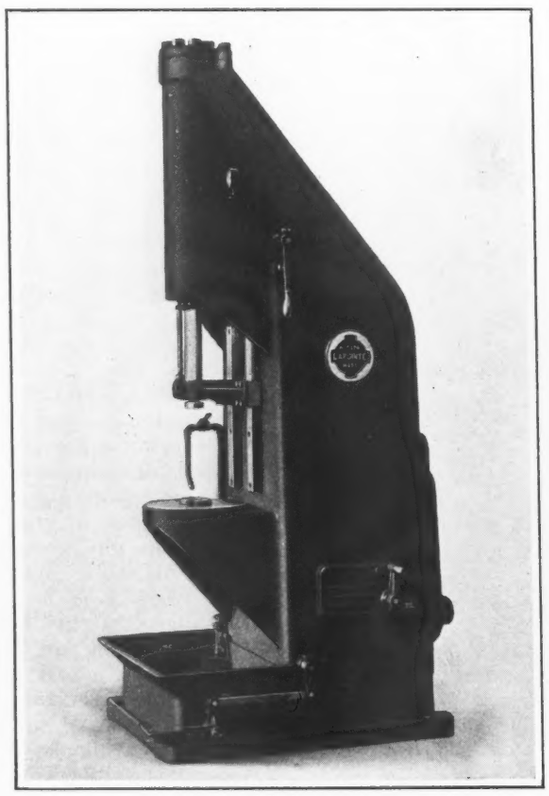
Vertical hydraulic presses of the construction illustrated have been brought out by the Lapointe Machine Tool Co., Hudson, Mass., for push-broaching, assembling, and general pressing or forcing. These presses are made in two sizes having capacities of 6 and 12 tons. One of the important features of these machines is that the entire hydraulic unit, including the West pump, motor, and silent chain drive, can be easily removed for inspection.

Both foot and hand operation are provided for. The foot-pedal control is intended for operating the press on production work and is of the non-repeat type. When the pedal is depressed, the ram will make a down stroke, return to its upper position, and stop. The hand-lever can be used to obtain the same cycle, and it can also be used for stopping the ram at any point of the stroke, either up or down. In addition, it is used for "inching" in setting tools.

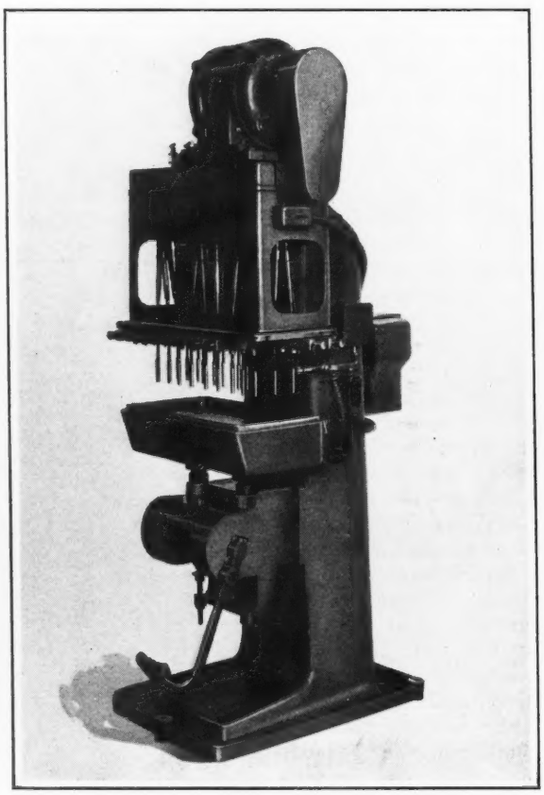
On the 6-ton press, the ram speed on the down stroke is adjustable from 0 to 27 feet per minute, and on the up stroke, from 0 to 60 feet per minute. On the 12-ton machine the maximum downward and upward speeds are 20 and 55 feet per minute, respectively. The ram speed is controlled by means of a lever on the right-hand side of the machine, while the length of stroke is controlled by an adjusting collar on the knock-off shaft. The maximum stroke is 24 inches, and the minimum 2 1/2 inches. The 6-ton machine weighs approximately 5550 pounds, and the 12-ton machine 5850 pounds.

Ex-Cell-O Semi-Automatic Multiple-Spindle Drilling and Tapping Machine

A multiple-spindle machine designed primarily for tapping work submerged in cutting compound was recently built by the Ex-Cell-O Aircraft & Tool Corporation, 1200 Oakman Blvd., Detroit, Mich. Twenty-one fully adjustable spindles are provided on the machine, the minimum center distance being 7/16 inch. The spindles are designed for either drilling or tapping holes



Lapointe Hydraulic Press, which is Built in 6- and 12-ton Sizes



Ex-Cell-O Machine for Tapping Parts Submerged in Cutting Compound

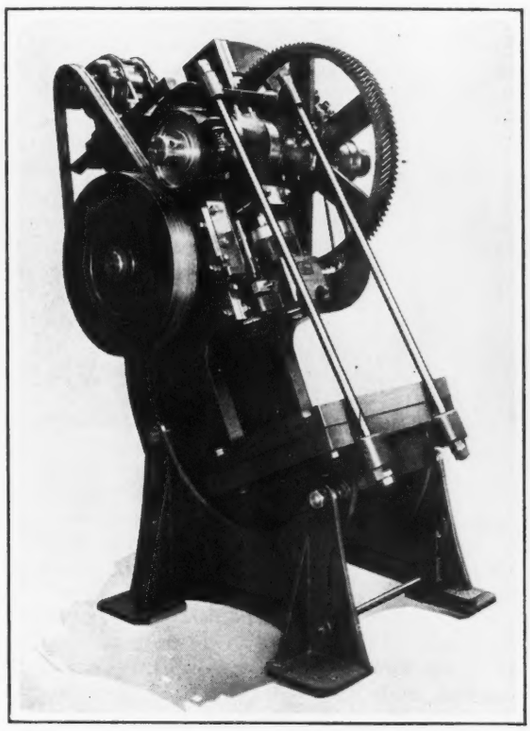


Fig. 1. Verson All-steel Press with Tie-rods to Withstand Severe Service

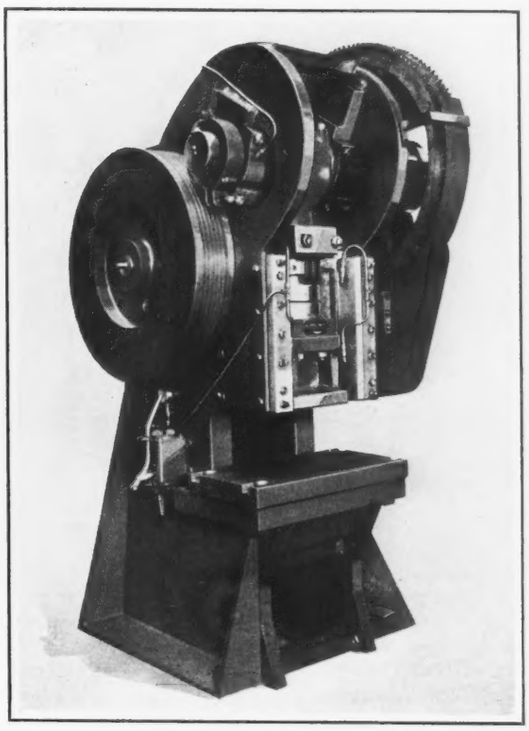


Fig. 2. Verson Open-back Gap Press with Split Bearings in a Solid Frame

that do not exceed 1/4 inch in diameter.

The table of this machine is raised to meet the drills or taps. The table proper is mounted on two plungers within a tank or container filled with the cutting compound. The entire table unit is so designed that when the foot-pedal is depressed, the central work-table remains stationary for a portion of the stroke, while the tank moves upward. This causes the work to be submerged in the cutting compound for the drilling or tapping. When the foot-pedal is released at the end of the operation, the work-table emerges from the cutting fluid for reloading.

For tapping operations, the spindles are threaded through their support arms to suit the lead of each individual tap. With this arrangement, the taps are fed into the work without cutting away or stripping the first few threads of the hole being tapped. A reversible motor is provided for tapping. Power is transmitted from the motor to the machine by a Texrope drive.

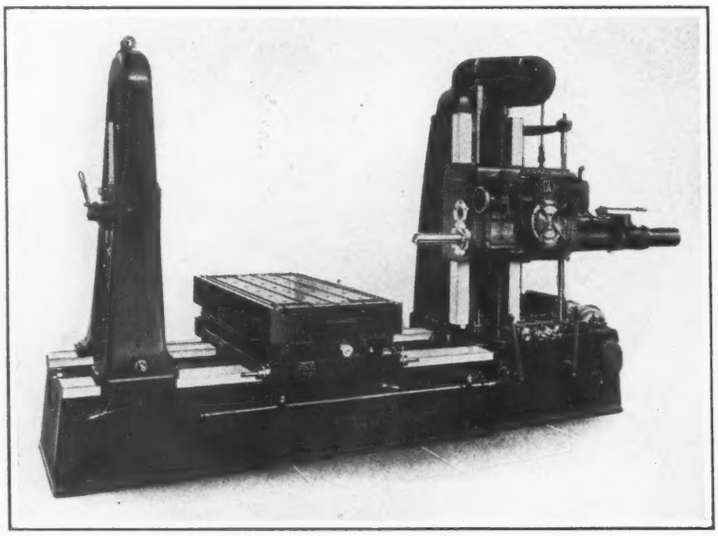
Verson Improved All-Steel Presses

A number of improvements have been made in the Verson all-steel presses since the recent organization of the Allsteel Press Co., 12,015 S. Peoria St., Chicago, Ill., for manufacturing this line of machines. These improvements include the use of steel herringbone gears and outboard clutch and gear supports. In the case of the open-back inclinable press, tie-rods have been added, as shown in Fig. 1, to enable the press to withstand severe service. The open-back gap press is now provided with split bearings in a solid frame, as shown in Fig. 2. Compactness is one of the features of this press, as it measures only 110 inches high over all, even though it has a capacity of 150 tons under continuous operation.

These presses are of arc-welded steel plate construction. As patterns have been practically eliminated in building them, special requirements of users can be met by cutting the steel to longer or shorter dimensions.

Giddings & Lewis Two-Spindle Boring, Drilling, and Milling Machine of Smaller Size

Two spindles—the conventional main spindle and an auxiliary high-speed spindle—comprise one of the principal features of the No. 70 horizontal boring, drilling, and milling machine built by the Giddings & Lewis Machine Tool Co., Fond du Lac, Wis., which was described in June MACHINERY, page 791. The same concern is now bringing out a smaller No. 30 machine which incorporates this and various other features of the previous machine. The main spindle of the No. 30 machine is 3 inches in diameter and has thirty-six speeds ranging in



Giddings & Lewis Smaller-sized Boring, Drilling, and Milling Machine with Two Spindles

geometrical progression from 8.3 to 500 revolutions per minute. The auxiliary high-speed spindle is 2 inches in diameter and has thirty-six additional speeds between 25 and 1500 revolutions per minute. As on the larger machine, the thirty-six speed changes of either spindle are controlled through two levers conveniently located. Indicators facilitate the selection of the desired speed.

Eighteen feeds for either spindle are obtainable through a unit attached to a front cover plate on the head. The feeds are obtained through rotary gear-change and back-gear levers. Pick-off gears permit any desired positive lead, and a slow hand feed is also available for each spindle.

Within the front head end of the bed there is a separate feed mechanism for moving the different units of the machine. Milling feeds are obtained from a separate drive shaft ahead of the start, stop, and reverse clutches. With this arrangement, reversal of the machine does not reverse the feed or the rapid traverse.

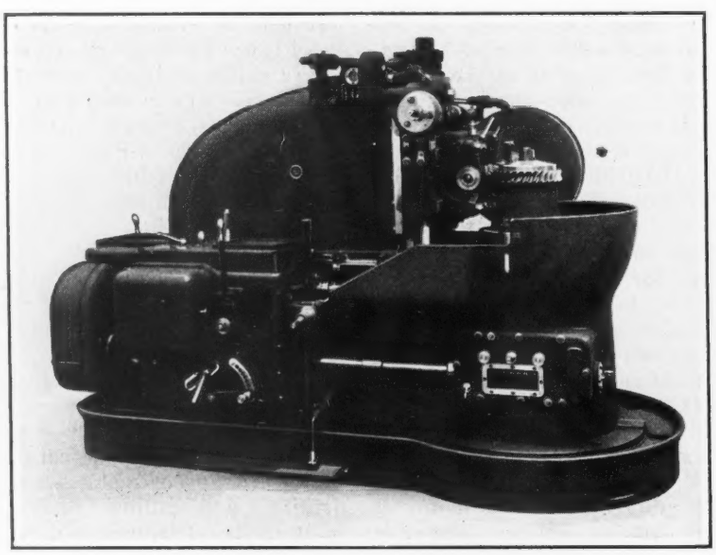
Like the No. 70 machine, the No. 30 machine can be furnished in table, planer, and floor types, the principal units being the same in all types. The important specifications of this machine are as follows: Range of main spindle feeds per spindle revolution, from 0.007 to 0.375 inch; range of auxiliary spindle feeds, from 0.002 to 0.125 inch per spindle revolution; range of milling feeds, from 0.8 to 40 inches per minute; rate of rapid traverse to all units, 120 inches per minute; and horsepower required, 15.

This machine is available in a wide range as regards the size and travel of the different units. On the table type machine, the maximum distance between the spindle nose and the end support can be as long as is required with tables up to 36 by 72 inches. On the planer type machine, practically any size of table can be supplied, while on the floor type, the travel of the column on the runway and the width and length of the floor plate can be made to suit requirements.

Pfauter Worm-Wheel Hobbing Machine

Three methods of feeding are available with the Pfauter worm-wheel hobbing machine illustrated, which is being placed on the market by the O. Zernickow Co., 21 Park Row, New York City. The first of these methods consists of feeding the tool radially toward the gear, and the second, of feeding the tool axially toward the gear. The third method comprises a radial feed for roughing and an axial feed for finishing.

The radial feed movement requires only the rotation of the gear and cutter in respect to each other in the ratio of their respective numbers of teeth. On the other hand, the axial feed necessitates an auxiliary rotation of the work corresponding to the feed used. This rotation



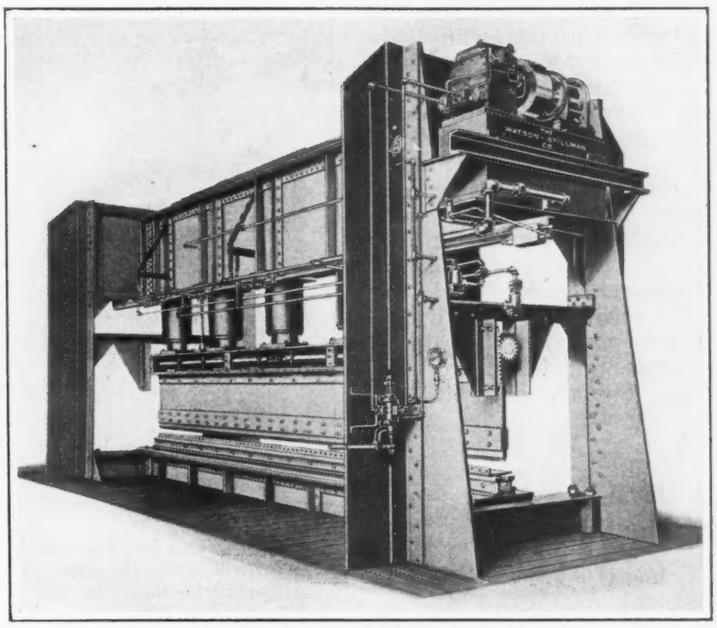
Pfauter Worm-wheel Hobbing Machine with Three Feeding Methods

is effected by a differential drive in such a way that the differential gear train is independent of the feeding rate. The second method can be employed not only with hobs, but also with fly-cutters. For this purpose, an indexing and setting device is provided.

The cutter-spindle and its outer bearing are carried in a slide mounted on a swivel base which imparts the axial movement to the cutter. The radial movement of the cutter toward the work is obtained by moving the machine upright, together with the whole hobbing saddle, along dovetailed guides on the bed. The hobbing head can be locked rigidly on the upright and the hob slide can be locked on its swivel base.

Pick-off gears permit of using speeds best suited to the cutter and work. The rate of feed is quickly changed by means of a single lever. Both the radial and axial feeds are disengaged automatically at predetermined points, and the cutter drive can be made to stop simultaneously with the feed. A quick power travel provided for both the hob slide and upright can also be disengaged automatically.

The index drive has been designed to permit small ratios between the cutter- and work-spindles when dealing with small numbers of teeth and multiple-start worm drives. The important specifications of this machine are as follows: Maximum diameter of worm-wheel accommodated, 19 3/4 inches; maximum circular pitch, 1 1/2 inches; minimum and maximum center distance between cutter and gear axes, 2 and 13 inches, respectively; axial movement of hob, 7 7/8 inches; maximum diameter of hob, 6 1/4 inches; diameter of work-table, 15 3/4 inches; and weight of machine, about 5 tons.



Hydraulic Bending and Forming Brake of Structural-steel Riveted or Welded Design

Watson-Stillman Plate Bending and Forming Hydraulic Brake

The Watson-Stillman Co., 107 Aldene Road, Roselle, N. J., has collaborated with the Duff Patents Co. in developing the heavy plate bending and forming hydraulic brake here illustrated. The advantages claimed for this equipment include speed of operation; large range of work, both in shape and size; sensitive control of the variable speed; and low maintenance cost.

The steel frame can be either welded or riveted. The large open ends allow easy endwise removal of the finished piece and also permit the bending of plates that are longer than the die, thus extending the lengthwise capacity of the machine to accommodate any existing plate length. Because the frame is of welded or riveted steel construction, the dimensions of the end opening and the length of the bed can be conveniently varied to suit requirements. Also, if desired, the frame can be fabricated by the user in order to reduce freight charges.

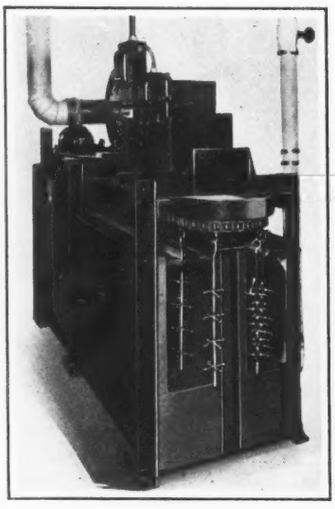
The bending beam is kept in alignment with the base by means of a parallel motion arrangement. Hydraulic cylinders installed on fixed centers operate the beam. The cylinders can be spaced equally in order to distribute the load evenly for the entire length of the bending die or they can be spaced irregularly so as to exert different pressures at predetermined points. This brake is built in 250-, 500-, and 1000-ton capacities.

Metalwash Twin-Tunnel Drying Machine

A low-heat continuous drying machine of the construction illustrated has been developed by the Metalwash Machinery Co., Inc., 117-119 E. 24th St., New York City, for miscellaneous metal parts coming from cold- or hot-rinse tanks. This equipment has two drying chambers for either hot or combination hot and cold blast drying. The single-chain return conveyor mounted on top of the blast chambers carries the work through. It enters at the left and returns at the right. Thus one operator can conveniently load and unload.

The U-shaped blast chambers contain steam radiating fin coils. An exhauster creates a pressure

in the chambers which forces hot air through patented adjustable nozzles against the passing work. This air blows off water globules from the work, while at the same time the heat absorbs the remaining moisture. In order to eliminate water spots as much as possible on highly polished work, the heat in the left chamber may be shut off to prevent actual drying, and the cold blast alone used to drive off all excess liquid. The remaining moisture will be evaporated while the work is passing through the heated return tunnel.



Metalwash Drying Machine which Returns Work to the Operator who Loads It

Federal Sixty-Five Ton Inclinable Press

A Model 6 open-back inclinable punch press with a capacity of 65 tons has recently been added to the line of machines built by the Federal Press Co., Elkhart, Ind. While the illustration shows a geared type, this press is also built in a flywheel style. The new model is of the same general design as other presses built by the company.

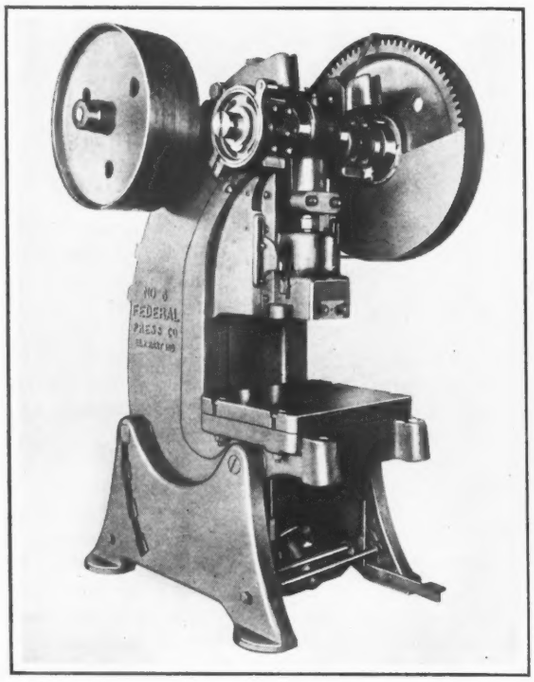
Timken roller bearings are provided for the back-shaft of the geared presses. The brackets are cast integral with the frame, and they are bored at the same time as the main bearings so as to insure accurate alignment of the shaft.

The flywheel type of press weighs 9000 pounds, and the back-geared type 11,300 pounds. Both types are equipped with a reclining bracket which operates from the front of the press and is removable, thus leaving the floor space clear for tote boxes. A patented non-repeat tripping mechanism is provided as standard equipment.

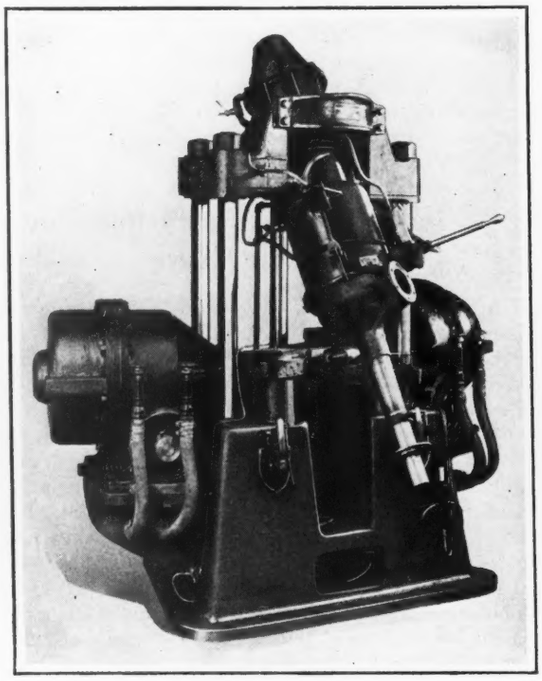
Hanna Multiple Riveting Machine

A multiple riveting machine developed especially for use on the rear-axle housings of Ford motor trucks has recently been produced by the Hanna Engineering Works, 1765 Elston Ave., Chicago, Ill. In the accompanying illustration, the housing assembly is shown clamped in the loading position. From this position it swings into alignment with the rivet dies, where it is locked by power. The clamps are power-actuated.

The rivets are inserted from the outside and headed on the inside. The four rivets that attach the axle tubes to the differential housing are driven simultaneously. Then the entire assembly is indexed and the remaining four rivets are driven into place. A predetermined ton-



Federal Inclinable Punch Press of 65 Tons Capacity



Hanna Riveting Machine for Rear-axle Housings

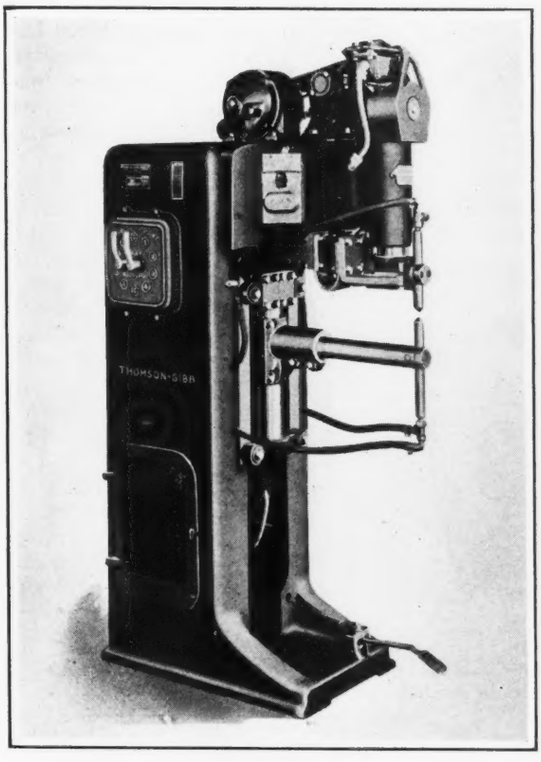
nage is exerted equally on all rivets.

A heading mandrel that expands automatically compensates for variations in the inside diameter and eccentricity of the axle tubes. This mandrel is operated by power to expedite loading.

Thomson-Gibb Press Welder

A medium-duty automatic spot and projection welder with a smooth straight spindle press type of action has been added to the line of welding machines and operates at the fastest speed as compared with former designs. The driving mechanism consists of only two units, the motor and worm reduction and clutch unit. The clutch has nine points of engagement, making operation instantaneous. The transformer is water-cooled, and is of a patented design which provides sixteen welding heats.

This machine is capable of developing welding pressures up to 900 pounds. A scale located



Thomson-Gibb Automatic Spot and Projection Welder with Straight Spindle Action

Fig. 1. Gleason Sharpening Machine for Spiral-bevel Gear Cutters up to 6 Inches

built by the Thomson-Gibb Electric Welding Co., Bay City, Mich. The principal features claimed for this press are unusually smooth action, with no hammering of the welding points; speedy operation; and the production of welds with practically no discoloration or depressions.

Another advantage is the flexibility of design which permits of readily changing the fundamental characteristics of the machine. For example, if the owner of a 12-inch throat machine that has a 1-inch stroke desires a machine with a longer throat, a different stroke, and a slower speed, it is only necessary to obtain a few new parts in order to make the desired change. Anti-friction bearings are used throughout the construction.

The complete driving mechanism is mounted on top of the machine, thus reducing the floor space approximately 30 per cent in the head facilitates the recording of correct pressure settings for all jobs. Speeds of from 30 to 160 spot welds per minute are available. The machine is built with throat depths of 12, 18, and 24 inches.

Gleason Spiral Cutter Sharpener

The circular cutters used on the small spiral-bevel gear generator built by the Gleason Works, 1000 University Ave., Rochester, N. Y., can be sharpened in a machine recently brought out by that concern, which is illustrated in Fig. 1. This equipment will sharpen cutters up to and including 6 inches

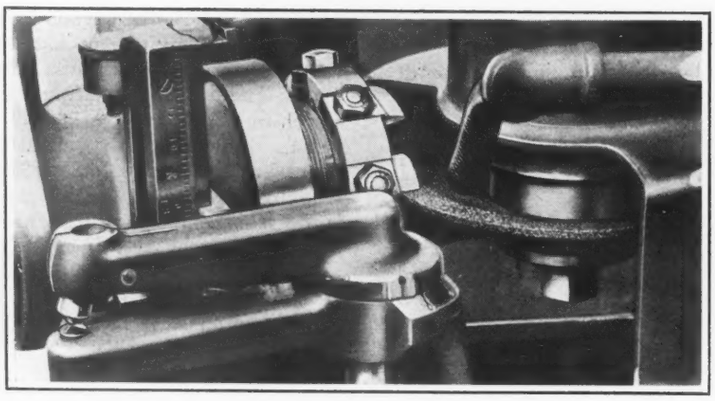


Fig. 2. Applying a Spiral-bevel Gear Cutter to the Dish-shaped Grinding Wheel

in diameter, designed for cutting gears by the spread blade, duplex spread blade, or standard methods. In other words, cutters with all inside or all outside blades or with both inside and outside blades can be sharpened.

The cutter-spindle is adjustable to any desired angle. The head that carries this spindle is swung to and fro to move the cutting edge of each blade across the face of the grinding wheel in the manner shown in Fig. 2. The proper setting of the cutter is effected by hand-nuts, and a gage is provided for checking the sharpening operations. The grinding is always against the cutting edge of the blade so as to reduce the possibility of burned or burred edges.

The grinding wheel is 8 inches in diameter and is of a standard dish shape. The wheel-spindle runs in ball bearings, and is driven by a one-horsepower motor located in the base and connected to the spindle through a belt. The grinding wheel is dressed to the desired angle by swinging a diamond to and fro across its face. The index mechanism of the machine is of the notched blade type and is hand-operated. The machine weighs approximately 1500 pounds.

Cutler-Hammer Starter for Small Motors

A three-pole, across-the-line, manual starter for all types of alternating-current squirrel-cage motors up to 2 horsepower is being placed on the market by Cutler-Hammer, Inc., 1295 St. Paul Ave., Milwaukee, Wis. The

Cutler-Hammer Starter Designed to be Mounted Directly on a Machine

principal advantages of this starter, which is known as "Bulletin 9115," include small size, thermal overload relays, and twin-break silver-to-silver butt-type contacts.

The starter is 4 7/16 inches wide by 8 9/16 inches high by 3 7/8 inches deep, being small enough to be mounted directly on a machine close to the operator. The thermal overload relays operate directly on the contact mechanism and open all three poles on an overload.

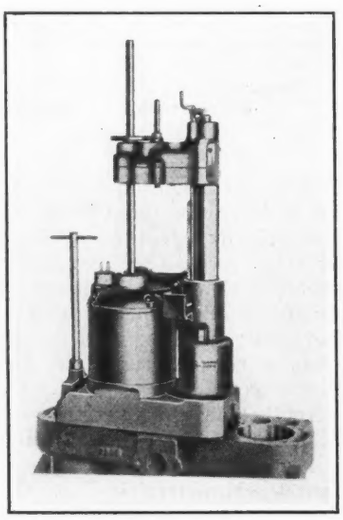
The cover interlock prevents opening the enclosing case when the motor is running. The case and operating lever can be padlocked in the "off" position or the case only can be padlocked.

Van Norman Per-Fect-O Boring-Bar

A boring-bar designed for reconditioning automobile cylinders by the use of a single fly cutter tipped with tungsten carbide is being placed on the market by the Van Norman Machine Tool Co., Springfield, Mass., under the trade name Per-Fect-O. The cutter blade revolves at 250 revolutions per minute and produces an accurate bore with a high finish.

The bar is centered in the bore by means of four non-revolving expanding supports which make up a "catspaw." Expansion and contraction of these supports are controlled by a knob at the top of the bar. The bar can be accurately centered in any part of a cylinder bore from the top to the bottom. While boring, the "catspaw" is expanded to give a rigid, non-revolving support to the cutter. This avoids any chance of taper or out-of-roundness.

The cutter is accurately set to the desired size by means of a micrometer. Once set, it need not be reset until all the bores in a block have been finished. A sharpening fixture consisting of a disk impregnated with diamond dust is supplied. When the cutting edge becomes dull, only a few seconds are required to obtain a sharp edge.



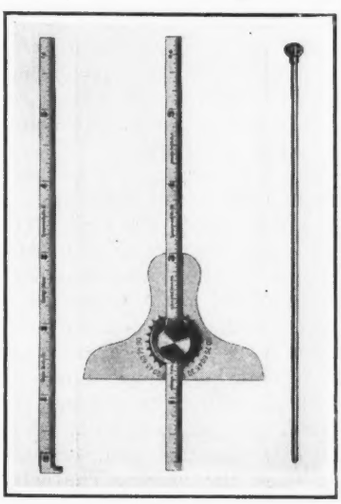
Boring-bar for Reconditioning Automobile Cylinders

By means of a new clamping method, the outfit can be secured to a cylinder block in less than a minute without the use of bolts, nuts, straps, or wrenches. It is mentioned that a Ford Model T cylinder block can be finished, ready for piston fitting, in less than thirty minutes, the actual boring time being about four minutes. The weight of this outfit is 87 1/2 pounds. It is suitable for bores from 2 5/8 to 4 1/2 inches.

Union Adjustable-Angle Depth Gage

A depth gage designed to enable an unusual number of angular settings to be made has been placed on the market by the Union Tool Co., Orange, Mass. As will be seen from the illustration, the head of this gage is marked 15, 30, 45, 60, 75, and 90 degrees on both sides of the adjusting stud.

To set the gage at a certain angle, the nut is released about one-quarter of a turn toward the left, and the rule is swiveled until a line on the washer matches the required number of degrees on the head. The indexing finger on the washer then drops into a slot, after which the rule is adjusted lengthwise to the correct position. When the nut is retightened, the tool is ready for use.



Depth Gage which can Easily be Set to Different Angles

Holes too small in diameter for the rule may be measured by the rod seen at the right in the illustration, which is 6 inches long by 3/32 inch in diameter. The rule at the left is provided for calipering.

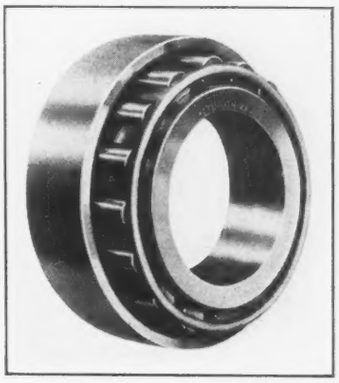
Mathews Ball Transfer

A "ball transfer" designed to assist the movement of work in any direction in a horizontal plane has been developed by the Mathews Conveyor Co., Ellwood City, Pa. As will be seen from the illustration, this device consists of a large hardened steel ball that rotates on smaller balls held in a cupped base. Dust and dirt are excluded from these balls by a cap which is held in position by means of a spring retainer.

Mathews Ball Transfer Designed to Assist the Handling of Flat Parts

Two models of the ball transfer are available, one for mounting in series on a table, and the one illustrated, which is intended for mounting on pipe supports. A group of these ball transfers provides an effective means of moving heavy shapes to and from shears, moving boxes to and from roll or power conveyors, and turning heavy work in machining operations.

The transfer is made in three types equipped with a 1 1/2-inch ball supported by 105 balls 3/16 inch in diameter. These types have a load rating of 200 pounds. Another type has a 2-inch ball supported on 65 balls 5/16 inch in diameter. This type has a load rating of 500 pounds.



Roller Bearing in which the Rollers are Free to Move Across the Outer Race

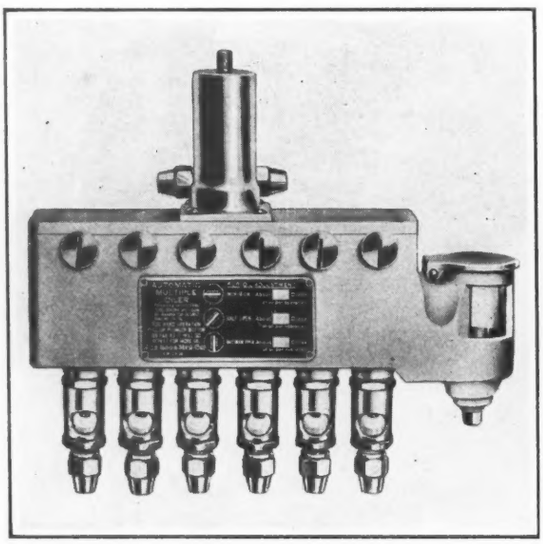
Aetna Roller Bearings

A complete line of roller bearings has recently been brought out by the Aetna Ball Bearing Mfg. Co., 4600 Schubert Ave., Chicago, Ill., for service where heavy loads and sudden shocks are encountered. Light-, medium-, and heavy-duty bearings are included in the line, which comprises sixty-four bearings ranging from 1 3/16 to 10 7/16 inches outside diameter. These bearings are standardized and are interchangeable with other makes and types of bearings as to inside and outside diameters. They are also interchangeable with S.A.E. standard bearings.

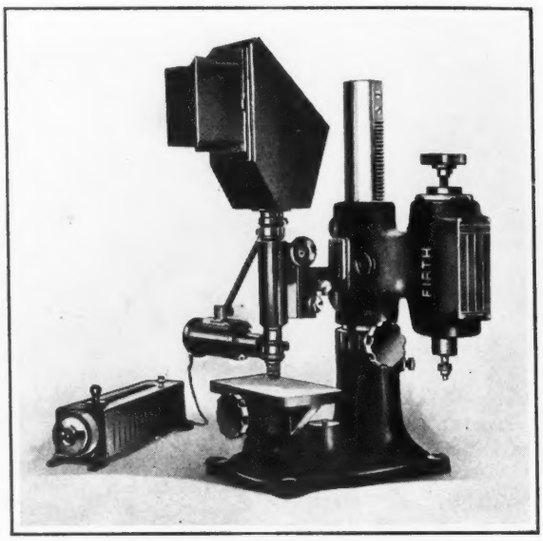
The outer race is free from lips or shoulders, while the inner race has a double lip. The rollers are free to move longitudinally across the face of the outer race, and consequently, endwise movement of the shaft due to load, expansion, contraction, or distortion can take place without misalignment or cramping. The design of the retainer is such that the over-all width of the race has been reduced without decreasing the roller bearing surface. Either steel or brass cages are supplied.

Hisey-Wolf Bench Grinder with Improved Motor

An improved commutating-type repulsion induction motor designed to comply with the



Gits Automatic Multiple Oiler Designed for High-Speed Production Machinery



Firth Hardometer with Micro-projection Head that Facilitates Readings

stringent electric codes in effect in many localities has recently been applied to the 6- and 7-inch wheel-grinder made by the Hisey-Wolf Machine Co., Cincinnati, Ohio. The principal advantage claimed for this motor is an unusually low starting current under all conditions. Low voltage due to line drop has no objectionable effect on the motor. In appearance, the grinder is the same as the one that was described in the May, 1928, number of MACHINERY, page 721.

Gits Bros. Automatic Multiple Oilers

Automatic multiple oilers designed for application to high-speed production machinery have been added to the line of lubricating equipment made by the Gits Bros. Mfg. Co., 1846-62 S. Kilbourn Ave., Chicago, Ill. These oilers are designed to lubricate any number of bearings at intervals of fifteen minutes, thirty minutes, forty-five minutes, one hour, three hours, or other intervals as desired. The intervals are regulated by timing controls.

Various types of oilers are included in the line. The illustration shows a pneumatic oiler intended for use in shops equipped with compressed air. Only 30 pounds of air pressure is necessary to operate the oiler in conjunction with the timing control. There is also an electric-solenoid-operated oiler which requires a small motor connected to an electric timing control. Mechanically operated oilers are made to be operated by a moving part of the machine being oiled. On these oilers, the timing control is attached.

One of the important features of these oilers is that they cannot become clogged by particles in the oil, as the smallest lead from the reservoir to the bearing is not less than 3/16 inch. The oiler is installed above the bearings of the machine and the opening in each lead is above the oil level in the reservoir. The height of the openings can be adjusted by screws on the outside. When the oiler operates, the oil-cups are raised out of the oil-well to a fixed position and deliver oil to the openings. The cups deliver various quantities of oil from 1/4 to 10 drops, depending upon the adjustment.

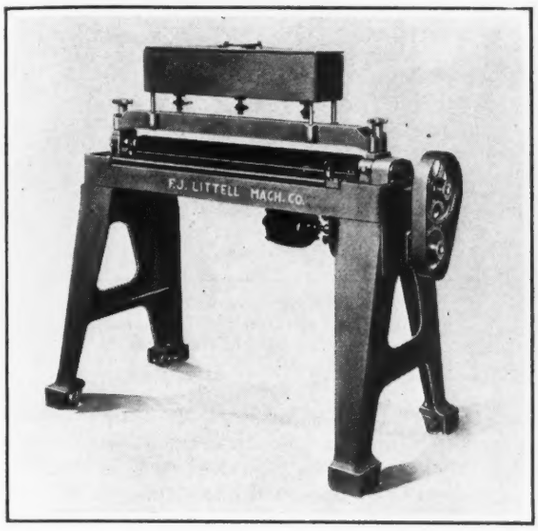
In cases where three or four oilings per day are sufficient, the oilers can be hand-operated. These multiple oilers are made in eleven sizes with from two to twelve leads. Single-feed automatic oilers are also manufactured by this concern.

Firth Hardometer with Micro-Projection Head

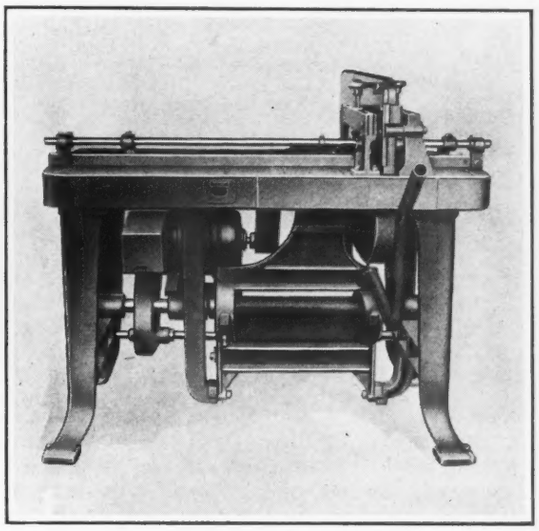
The Firth Hardometer, which is sold by the Tinius Olsen Testing Machine Co., 500 N. 12th St., Philadelphia, Pa., may be fitted with a micro-projection head, as illustrated, to aid the user in quickly measuring indentations made in metal parts for determining their hardness. This instrument differs from other machines used for similar purposes in that instead of measuring the depth of the indentation, it measures the diameter or the diagonal distance across the indentation. Accuracy and speed of operation in testing thin materials, small objects, and hardened surfaces are the principal advantages claimed.

The indentations may be made either with a small steel ball or a pyramid-shaped diamond. The ball is used on thin or soft materials, while the diamond is used on hardened or Nitralloy surfaces. The diamond is also preferable for use on hardened gear teeth or wherever a minimum mark is desired on the surface tested. Light loads from 10 to 120 kilograms are used, depending upon the general character of hardness testing to be done.

The Hardometer may be obtained with or without the



Littell Power-driven Machine for Oiling Sheets up to 36 Inches in Width



Campbell Abrasive-disk Cut-off Machine which Handles Extra Wide Stock

micro-projection head. In the standard instrument, the reading of the indentation is made through a microscope that is swiveled into position as the indenter head is swung away. The micro-projection head is mounted on this microscope and speeds up hardness tests by throwing an enlarged image of the indentation on a ground glass screen with scales. When the ball indenter is used, the image is round, and when a diamond indenter is employed, it is square.

Littell Power-Driven Sheet-Oiler

A power-driven machine for oiling sheets up to 36 inches wide, not exceeding No. 12 gage in thickness, has just been placed on the market by the F. J. Littell Machine Co., 4127 Ravenswood Ave., Chicago, Ill. After the operator pushes the sheet into the power-driven rolls, the rolls thoroughly oil the stock and a wiper removes the excess oil. A 1/2-horsepower motor, through a reduction unit, supplies power for feeding the sheets at the rate of 100 feet per minute.

The oiling rolls are made up of felt washers, 1 inch thick. The rolls can be easily taken out of the machine to replace worn washers. Casters on the legs make the machine portable, so that it can be conveniently used in any part of the shop. It is possible to wedge the machine against the floor when it is desirable to do so. An electric switch stops the equipment in case it becomes overloaded.

Campbell Abrasive-Disk Cutting-Off Machine

Materials of certain characteristics up to 1 inch in thickness and 16 inches in width can be cut in from two to twelve seconds by the abrasive disk of a Model 30 cut-off machine now being placed on the market by Andrew C. Campbell, Inc., Bridgeport, Conn. Nickel silver, soft iron, hardened high-speed steel, and similar metals can be cut in widths up to 6 inches if the thickness is not more than 3/4 inch. If the materials are thinner, correspondingly wider cuts can be made.

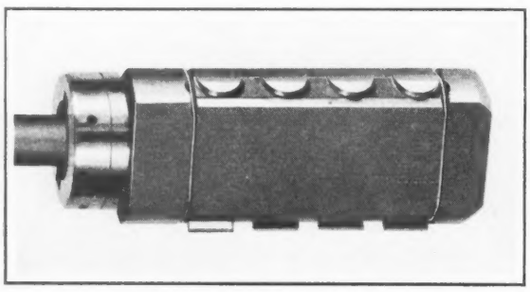
The arrangement provided for moving the abrasive disk through the material is of interest. The travel arm is arranged in such a manner that the spindle travels parallel with the top of the table without the use of slides. Dirt and grit cannot enter the moving parts.

The motor is started and stopped by means of a push-button. A straightedge provides for cutting to desired angles. Six V-belts insure positive driving of the spindle. Both regular and irregular shapes may be cut.

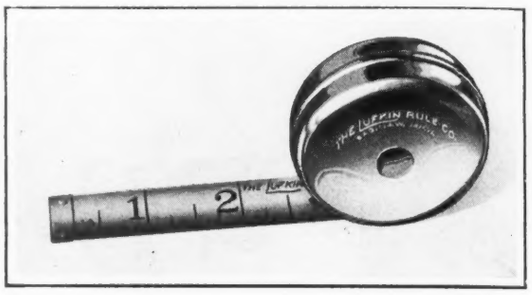
Hutto "Revociper"

A tool known as the "Revociper" has been developed by the Hutto Engineering Co., Inc., 515 Lycaste Ave., Detroit, Mich., for removing excess stock from bores to prepare them for honing. This tool is especially adapted for removing stock from long tubing, gun liners, rotor shafts, oil-feed shafts, etc. It is suitable for cold-drawn seamless steel, brass, and Monel-metal tubing, cast-iron and nickel-iron pipes, Nitralloy liners, and forged-steel tubes with bore diameters from 1 5/8 to 10 inches and lengths up to 65 feet.

When only a true bore is required, as in ship propeller shafts or in high-speed rotor shafts, the honing operation may be eliminated. A high satin finish can be produced by six complete reciprocations of the Revociper after the size has been obtained, the traversing speed being reduced slightly between the reciprocations so as to produce new cutting paths. Revocipers 4 1/2 inches in diameter and over are interchangeable with abrasive



Revociper for Removing Excess Stock from Long Bores Preparatory to Honing



Crescent Six-foot Tape-rule, of Tempered Steel, Made by the Lufkin Rule Co.

holders in standard Hutto honing equipment. In sizes from 1 5/8 to 4 7/16 inches a fixture is necessary for regrinding the cutting edges of the blades, but in larger sizes the cutting edges are ground while in the body.

Clark "Truclift"

A lifting type of power truck is being introduced to the trade by the Clark Tructractor Co., Battle Creek, Mich., which is provided with a four-wheel steering arrangement that enables the operator to turn sharp corners readily. Thus the truck can easily enter a freight car to deposit a load at the far end. This truck also has a rear wheel drive, cast-steel frame, full-floating rear axle, hydraulic lifting mechanism with automatic control, and a tractor type of gasoline engine.

One model of this truck has a narrow platform to accommodate United States standard 12-inch under-clearance skid platforms. It lifts a three-ton load in nine seconds, and has a turning radius of 94 inches. A heavier model lifts four tons in eight seconds, has a speed of from 1 to 6 miles per hour, and also turns on a 94-inch radius.

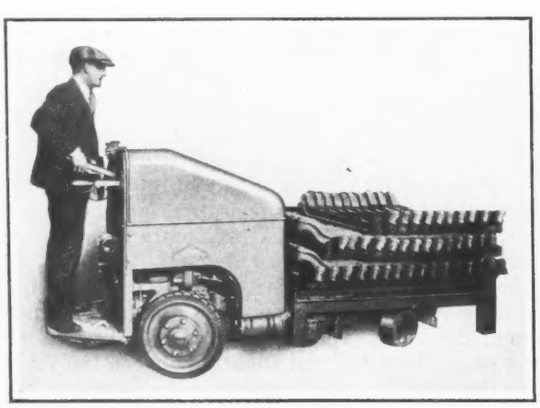
Lufkin Tape-Rule

A 6-foot measure which combines the convenience of a pocket tape and the utility of a rule has just been brought out by the Lufkin Rule Co., Saginaw, Mich. This is known as the Crescent tape-rule. It consists of an accurate steel tape which automatically winds into a case 2 inches in diameter and yet is rigid like a rule when withdrawn. This tape-rule is made in two models, the No. 696 being marked in sixteenths of an inch as illustrated, and the No. 696D, in tenths and hundredths of a foot.

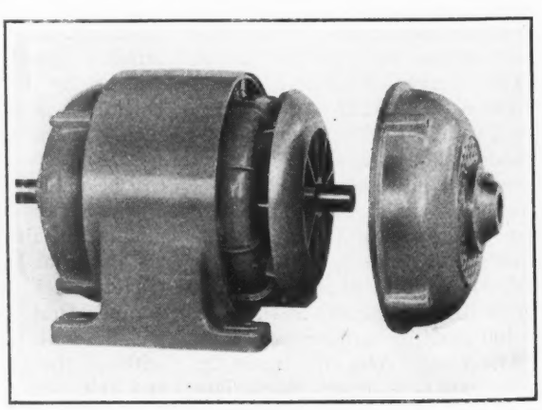
The measuring blade is of tempered steel, stiffened by special forming. It is nickel-plated and has prominent dark markings. Unsupported, it may be projected like a rule. It will also flex around circular, round-cornered, or other shaped objects. A clip at the outer end facilitates withdrawing the blade from the case and serves as a hook in taking measurements out of arm's reach. The case is chromium-plated and has a spring winding device with a ratchet stop. The blade is withdrawn manually and returned automatically under control by pressing a push-button.

"Klosd-Tite" Fan-Cooled Motor

Two cast-iron housings completely encase the bearings, air gap, rotor, and windings of the "Klosd-Tite" motor here illustrated, which has recently been designed by Sterling Electric Motors, Inc., 5401 Telegraph Road, Los Angeles, Calif. Air



Clark Lift Truck Having Four-wheel Steering Arrangement



Sterling Fan-cooled Motor of Totally Enclosed Construction

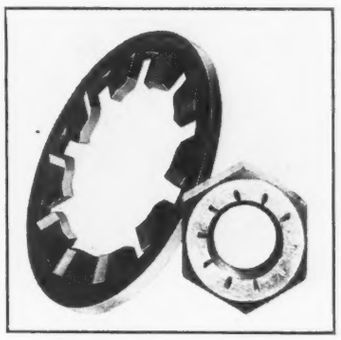
drawn by a fan through holes in one of the end covers circulates between the outer and inner housings and passes out through holes in the opposite end cover. Ball bearings are provided for the motor shaft. This motor is made to N. E. M. A. standard dimensions.

Vickers Hydraulic Relief Valve

A hydraulic relief valve operated by a piston that is in hydraulic balance regardless of the initial oil pressure or the pressure for which the valve is set is being introduced on the market by Vickers, Inc., 7746 Dubois St., Detroit, Mich. High sensitivity and accuracy throughout the pressure range are the advantages claimed for this construction. The valve is made in two sizes—for 3/4- and 1 1/4-inch pipe connections. Their capacities are from 0 to 15 gallons per minute and from 10 to 40 gallons per minute.

Hydraulic Relief Valve Operated by Piston that is Always Balanced

This valve is designed to be installed directly in the hydraulic line of machine tools. It can be installed in any position, and thus eliminates the customary tee. A "hydro-cone-shaped" valve prevents wire drawing and eliminates foaming, which would aerate the oil. By turning an adjusting screw, the pressure can be varied conveniently from one extreme to the other.



"Everlock" Washer and a Nut that has been Screwed on One

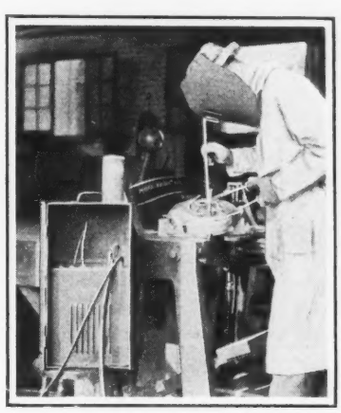
"Everlock" Washers

A lock-washer with die-formed teeth that bite into both the nut and work is being introduced on the market by Thompson-Bremer & Co., 1640 W. Austin Ave., Chicago, Ill. The teeth of this "Everlock" washer are hardened and heat-treated. The shape of the teeth is said to give the lock-washer unusual gripping power, and the nuts are held so firmly that vibration serves to drive the washer teeth deeper into the nut and work. At the right in the illustration is shown a nut that has been screwed tight against one of these washers. The cuts made by the washer teeth are readily apparent.

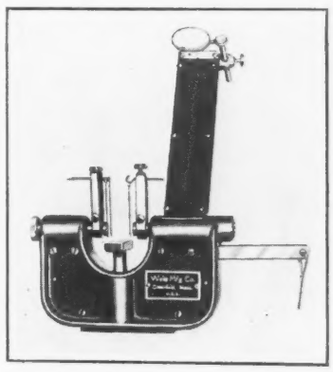
Electric Welding Torch

An electric welding torch that operates on 110- or 220-volt alternating-current lighting circuits is now manufactured by the Warner Engineering Co., Pomona, Calif. With this torch, a smooth steady flame is produced between carbon electrodes. Models operating on a 110-volt current weld practically all metals, including aluminum, and can also be used for hard soldering with German silver and silver solder.

The 220-volt models are intended for heavier work, and a special 220-volt welder is made that can also be used for carbon and metallic arc welding. The flame produced between the carbon electrodes is non-oxidizing.



Using the Warner Electric Welding Torch



Wells Gage which Magnifies Reading Three Hundred Times

Wells "Rapid Inspection" Gage

In a gage designed by the Wells Mfg. Co., Greenfield, Mass., for rapid inspection, the reading is magnified over three hundred times so that it may be easily and quickly seen. In checking screws or taps with this gage, either anvils or the three-wire system can be used. The pressure applied is the same all the time.

The anvil method is especially suitable for three-fluted taps. The anvils are opened by applying pressure on a foot-treadle, and they are closed by a spring, which insures the same measurement each time. Round or flat pieces can be inspected rapidly by using flat anvils. The gage is set by means of a standard plug.

In using the three-wire system, the wires are held in place as shown in the illustration. The wires are adjustable so that they can be used until worn the full length.

Brown & Sharpe V-Blocks and Clamps

Two new types of V-blocks and clamps recently added to the products of the Brown & Sharpe Mfg. Co., Providence, R. I., are shown in Figs. 1 and 2. The number 750B set illustrated in Fig. 1 has stepped clamping lugs and is especially suitable for use by inspectors. The blocks can be used on their sides, as the clamps

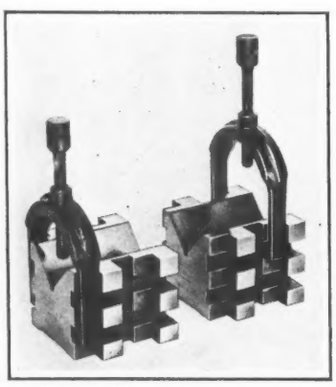


Fig. 1. Brown & Sharpe V-Blocks with Stepped Sides

do not project, while the stepped construction also allows the clamps to be changed quickly in order to accommodate work of various diameters up to 2 inches. The V-grooves are ground centrally and in alignment. The blocks are 2 1/2 inches long, 2 3/4 inches wide, and 2 inches high. They are made and sold only in numbered pairs.

With the V-block of the No. 750C set, shown in Fig. 2, the entire top of the work is accessible. The clamp provided with this block is designed to hold stock of square or rectangular cross-section, as well as round stock. A hole through the center of the block allows drills, drifts, etc., to project through the work. This block is 3 inches long, 4 3/4 inches wide, and 2 inches high.

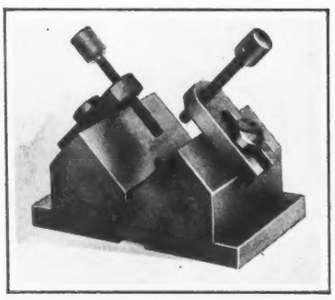
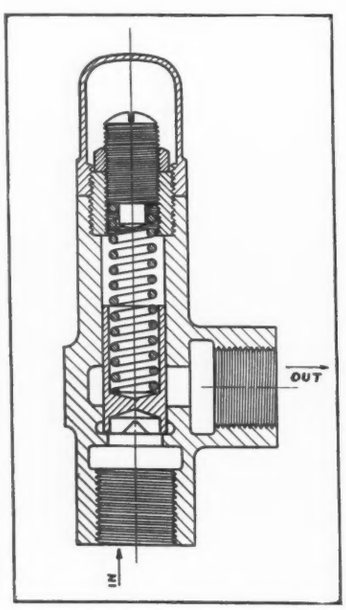


Fig. 2. V-block in which Top of Work is Accessible

It has a capacity for holding round stock up to 1 1/2 inches in diameter.

Fulflo Non-Chattering Oil Relief Valve

A non-chattering piston type of oil relief valve or by-pass valve recently brought out by the Fulflo Specialties Co., Blanchester, Ohio, is shown in the accompanying illustration. This valve is made in pipe sizes of from 3/8 to 1 1/4 inches, and is suitable for pressures of from 20 to 120 pounds per square inch. Adjustments can be made by removing the cap and turning the screw at the top of the valve.

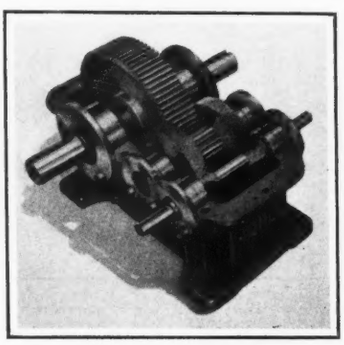


Construction of Fulflo Relief or By-pass Valve

The cylindrical piston seat of this valve closes the port in a shearing manner and thereby eliminates pounding or chattering. The valve is designed for use in connection with oil hydraulic pumping units when a specific pressure is to be maintained. It is especially suitable for the hydraulic mechanisms of machine tools, for oil burning equipment, etc. The valve is made of cast iron with a brass piston or with all parts made of bronze.

Jones Small "Herringbone-Maag" Speed Reducers

A series of speed reducers with herringbone and Maag spur gears has been brought out by

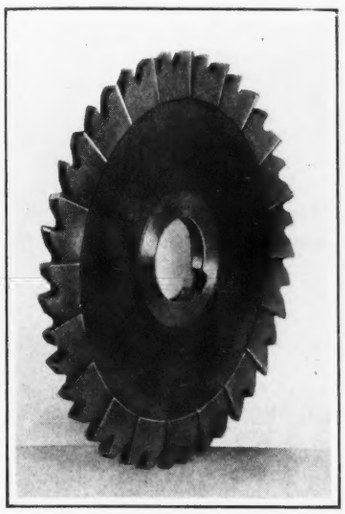


Jones Speed Reducer with Herringbone and Maag Spur Gears

the W. A. Jones Foundry & Machine Co., 4401 W. Roosevelt Road, Chicago, Ill., in capacities ranging up to 18 horsepower. The reduction ratios range from 12 to 1 up to 48 to 1.

To permit universal application, all reducers in this series have high- and low-speed shaft extensions on both sides. This eliminates the need of a right- or a left-hand assembly.

The herringbone gears and pinions used on the high-speed side are generated by rack-shaped cutters with straight sides in a gear planer. The Maag spur tooth form is used on the low-speed side to give the greater strength needed there. In this and other respects, the new reducers are reproductions of the larger "Herringbone-Maag" reducers made by this concern.



Brown & Sharpe Slitting Saw with Staggered Teeth

Brown & Sharpe Slitting Saws with Side Chip Clearance

Twenty-one sizes of metal slitting saws with side chip clearance have recently been added to the line of cutters made by the Brown & Sharpe Mfg. Co., Providence, R. I. These saws are of high-speed steel, and are so designed as to allow chips to be carried out of deep slots without jamming. In addition to pockets at the sides of the teeth, the sides of the saws are recessed. There is also a concavity on the lateral cutting edges. The extra clearances reduce rubbing and dragging, with attendant heating and jamming tendencies.

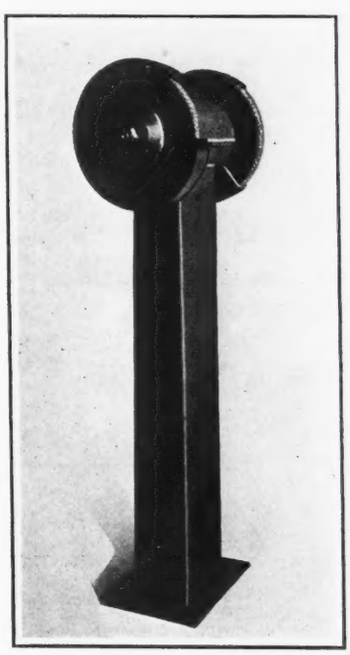
These saws are made in diameters of from 3 to 8 inches and in a suitable range of thicknesses. Saws up to and including 5/32 inch thick are made in the conventional straight-tooth type, while saws 3/16 inch thick are made in the staggered-tooth type illustrated.

Forbes & Myers Welded-Steel Tool Grinder

The electrically driven tool grinder of welded-steel construction that has recently been brought out by Forbes & Myers, 172 Union St., Worcester, Mass., weighs 175 pounds less than the old grinder of the same size which is made of castings. The new grinder also costs considerably less, even though it is a little more powerful than the one of previous design and just as strong.

This grinder is equipped with 10- by 1-inch wheels which run at 1800 revolutions per minute. The tool-rest provided on the left-hand end only is adjustable in two directions. A large opening in the right-hand wheel guard accommodates work that cannot be handled on a tool-rest. Both wheels are equipped with permanent guards. Ball bearings of the grease-seal type, packed with sufficient grease for one year of ordinary use, are furnished.

The motor is enclosed from the outside air, being cooled by air circulated through the stand. It is of the induction type and of 3/4-horsepower rating. The motor can be supplied for operation on 110-, 220-, 440-, or 550-volt, one-, two- or three-phase, 25- or 60-cycle current. Special motors can also be furnished when desired. The weight of this grinder is 90 pounds.



Forbes & Myers Tool Grinder of Welded-steel Construction

Flexible-shaft Equipment Made by the U. S. Electrical Tool Co.

Four-Speed Flexible Shaft Machine

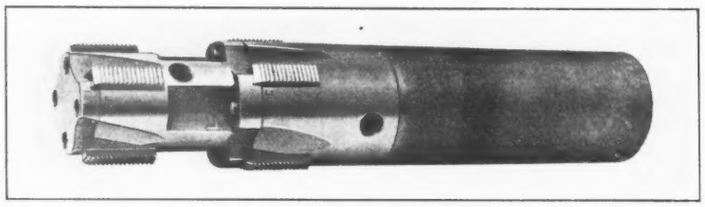
A belt-driven flexible shaft machine which can be run at four different speeds—950, 1250, 2400, and 3600 revolutions per minute—is shown in the accompanying illustration. This equipment is being placed on the market by the United States Electrical Tool Co., 2477 W. 6th St., Cincinnati, Ohio.

This four-speed machine is made in different horsepower sizes and with various styles of mountings, such as overhead or vertical, trolley, floor, or stand, and bench. A complete line of tools and attachments for flexible shaft uses, including mill-cut rotary files, is provided.

Among the special features of this machine are a spiral bearing that extends the full length of the housing, improved slide couplings that take up end play, and a new ball-bearing hand-piece.

Geometric Tap for Tapping Two Holes at Once

Two holes are tapped simultaneously by means of a combination solid adjustable tap recently brought out by the Geometric Tool Co., New Haven, Conn. In the size illustrated, one tap section is 2 1/16 inches in diameter,



Geometric Solid Adjustable Tap with Two Tapping Sections of Different Diameters

and the other is 2 11/32 inches in diameter. Both sections have fourteen threads, of U. S. form, per inch.

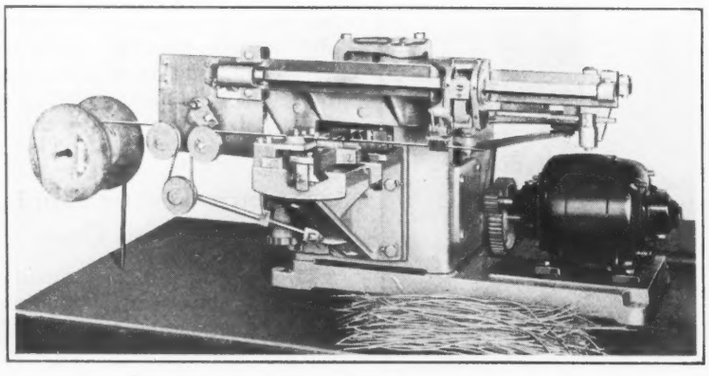
The two tap sections are independent of each other, having individual size adjustment controls. Thus both holes can be tapped to the required decimal sizes. When desired, the front tap can be removed and the back tool employed alone.

While the tap shown is used in a chucking machine, similar tools can be furnished for any type of machine in which a solid adjustable tap can be employed. Various sizes of tap sections can be provided, and they can be equipped with either ground-thread or machine-cut chasers.

Artos Automatic Wire Measuring, Cutting, and Stripping Machine

An automatic wire measuring, cutting, and stripping machine of bench type has been brought out by the Artos Engineering Co., 327 E. Brown St., Milwaukee, Wis., as a companion machine to the floor-type model built by this concern. The bench machine will automatically measure and cut wires to any desired length within its range, and in the same operation, will strip the insulation from either one or both ends. The stripped length is adjustable from 1/8 to 1 1/2 inches.

The machine is primarily designed for cutting wire up to lengths of 15 inches; however, attachments can be provided to permit cutting maximum lengths of 30, 45, 60, or 90 inches. On lengths up to 15 inches, the production capacity is 3000 pieces per hour. All sizes of wire up to No. 12 Brown & Sharpe gage can be handled.

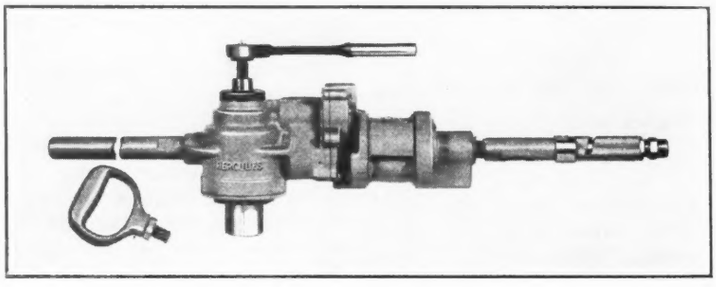


Machine for Automatically Cutting Wire to Desired Lengths and Stripping Insulation from the Ends

Hercules Portable Drill and Reamer

The heavy-duty drill and reamer illustrated has recently been added to the line of Hercules portable air tools made by the Buckeye Portable Tool Co., Dayton, Ohio. This tool is also made for nut driving, and is intended for use in structural steel work, shipyards, railroad shops and shops building heavy machinery. It has a weight of 40 pounds.

The drill is equipped with a No. 5 Morse taper socket, and the nut-driver with a 7/8-inch square spindle. Feeding of the tool is controlled by a ratchet wrench, but a spade handle or breast plate can be used in place of the ratchet if desired. The Hercules stationary valve motor is supplied. This tool follows the general construction of the drill and reamer described in November, 1930, MACHINERY.



Hercules Air-driven Drill and Reamer

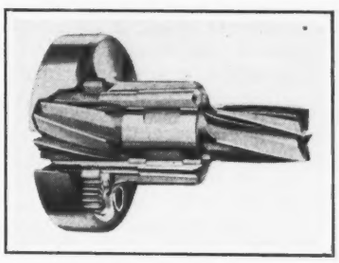
Thurston Chucks for Double End-Mills

Three improved chucks designed to hold the double end-mills made by the Thurston Mfg. Co., Providence, R. I., have been brought out by this concern. These chucks are applied directly to the nose of the milling machine, being fastened by means of four studs and driven by two keys. They are designed for application to standard milling machine noses.

The chucks have a tightening device operated by a single pinion which may be seen in the accompanying cross-sectional view. This pinion draws in the collet by means of a screw thread and two gears, and tightens the collet solidly. Three cams and pinions prevent the double end-mills from pushing in, pulling out, twisting, or turning.

The largest chuck of the three is illustrated. Three collets may be used with this S-5 chuck to accommodate double end-mills from 1/8 to 1 1/2 inches, inclusive. The S-1 chuck is intended for double end-mills from 1/8 to 1/2 inch, and the S-3 chuck for end-mills from 1/8 to 1 inch.

When one end of these double end-mills becomes worn, the operator merely reverses the tool to obtain a new end-mill.



Chuck for Thurston Double End-mills of Various Sizes

Gathering Installation Photographs Systematically

One of the large pump manufacturers of the country recently received a telegram as follows: "Pump does not function properly. Please send engineer to correct trouble." The telegram was from a customer who had recently had a new pump installed. After the installation, the pump company had asked for a photograph of it. When the telegram was received, the installation photograph was taken from the file and examined. It revealed the cause of the trouble. The connections to two rocker arms had been interchanged from the position indicated on the installation drawing. Instead of sending an engineer, the pump manufacturer sent a telegram suggesting that the connections be reversed. This was done, after which the pump operated properly. This is an example of the value of an installation photograph.

There are several good reasons for collecting installation photographs. One is that they have an important value in advertising. There is no more forceful way to present a sales message through the printed page than by showing photographs of products actually in use. These photographs are equally valuable in the salesman's brief case. A series of good installation photographs is worth an hour of sales talk.

The International Harvester Co. is a consistent user of photographs. This company relies largely upon the photographic work of employes; but rather than leave them to their own devices, the company makes a systematic effort to increase the effectiveness of the photographs by providing instruction in the making of pictures. The company has published a 40-page booklet "How to Make Pictures for the Harvester Company," which is a valuable text-book on photography. Anybody interested in photography will find much of value in this book. It discusses exposures, composition, and how to make pictures for advertising purposes.

To obtain good pictures, the company makes use of semi-professional equipment, usually a 5 by 7 view camera. Instead of a complete outfit being furnished to each branch, cameras are routed from one branch to another. Each branch retains the outfit for a sufficient length of time to make the required supply of photographs for the main office.

Manufacturers may be interested in the service available through the International Photographers' Association of America, whose "4000-mile lens" system makes it possible to obtain photographs at distant points. For example, if a manufacturer in Jersey City, N. J., wants a photograph made of machinery installed in Salt Lake City, Utah, he gives complete instructions to his photographer in Jersey City. This man forwards the instructions to a photographer in Salt Lake City, who makes the photograph and mails it to the Jersey City photographer with the invoice. This plan is being used by many firms.

Advantage may also be taken of the "Market Place," a monthly feature of *American Photography*, published at 428 Newbury St., Boston, Mass. Companies requiring photographs may describe their needs and in that way get in touch with men able to furnish them with the needed pictures. All this aids in the efficient conduct of American manufacturing enterprises.

* * *

German Engineers Celebrate Seventy-Fifth Anniversary

On May 12, the Society of German Engineers (*Verein deutscher Ingenieure*) had been in existence seventy-five years. It was formed in 1856 by twenty-three young and enthusiastic engineers in the small town of Alexisbad in the Harz Mountains. Hardly any of the founders had reached his thirtieth year. With youthful energy they set about making this the leading engineering society of Germany, and so well did they succeed that today the *Verein deutscher Ingenieure* has over 31,000 members. A memorial statue, dedicated to the founders of the Society, was unveiled at Alexisbad on the seventy-fifth anniversary. In addition, the anniversary was also celebrated at the annual meeting of the Society at Cologne, June 27 to 29.

* * *

According to the National Automobile Chamber of Commerce, of the 3,500,000 cars and trucks built last year, 2,900,000 were sold as replacements.

Personals

E. V. CRANE of the engineering staff of the E. W. Bliss Co., Brooklyn, N. Y., addressed the Pressed Metal Institute at its meeting in Detroit, June 5, on the subject "Metal Working in Power Presses."

GEORGE B. KARELITZ has been appointed acting manager of the mechanics division of the Westinghouse Research Laboratories to fill the vacancy caused by the recent promotion of John M. Lessells.

J. C. MCQUISTON retired as general advertising manager of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., June 1. Mr. McQuiston had been in charge of advertising for the company for twenty-nine years. Entering the advertising profession when it was in its infancy, he contributed greatly to its growth and organization, and many of the present high ethics of the profession are the result of his practice and preaching. It is understood that Mr. McQuiston is making plans to take an extended cruise around the world with his wife and daughter.

ARNO W. NICKERSON, who has been active in process development in the paper industry for a period of years, has joined the research engineering department of the Robert Gair Co., 420 Lexington Ave., New York City.

R. D. BEAN, formerly manager of the engineering development department of the Brown Instrument Co, 4485 Wayne Ave., Philadelphia, Pa., manufacturer of industrial measuring instruments, has been made chief engineer.

FREDERICK M. FEIKER, executive secretary of the Associated Business Papers, Inc., New York City, since 1926, has been appointed director of the Bureau of Foreign and Domestic Commerce of the Department of Commerce, Washington, D. C.

FRANK THORNTON, JR., manager of residence engineering, general engineering department, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has been appointed manager of association activities of the company, succeeding R. W. E. MOORE, who has resigned.

W. L. LEWIS has been elected executive vice-president of the Chicago Pneumatic Tool Co., 6 E. 44th St., New York City. Mr. Lewis has been vice-president in charge of finance for the last year, and was formerly assistant comptroller of the Bethlehem Steel Corporation.

D. J. QUAMMEN has been appointed manager of the Philadelphia district office of Cutler-Hammer, Inc., 1295 St. Paul Ave., Milwaukee, Wis., manufacturer of electric motor control and allied apparatus. MR. QUAMMEN succeeds F. J. BURD, who has been made assistant manager of the Chicago office.

A. D. HUNT, formerly manager of engineering at the South Philadelphia Works of the Westinghouse Electric & Mfg. Co., has been transferred to the Chicago office of the company. Mr. Hunt will be engaged in the company's steam apparatus activities in the western districts.

J. S. TRITLE has been elected vice-president and general manager in charge of manufacturing, sales, and engineering operations of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. He was formerly vice-president in charge of manufacturing operations.

MAURICE TAYLOR, welding technician for the Lincoln Electric Co., Cleveland, Ohio, sailed for Tokyo on June 20 from San Francisco. He expects to confer with officials in charge of ship construction for the Japanese Navy and supervise the installation of "Electronic-tornado" automatic welding machinery in the factory of the Kawasaki Co.

GEORGE F. NEWELL has been elected vice-president and general manager of the Pyrometer Service & Supply Corporation, 1988 E. 66th St., Cleveland, Ohio, a subsidiary of the Claud S. Gordon Co., Chicago, Ill., pyrometer and industrial X-ray engineers. Mr. Newell was previously the Chicago representative of the Charles Engelhard Co.

R. E. W. HARRISON, chief engineer of the Cincinnati Grinders, Inc., Cincinnati, Ohio, has been re-elected chairman of the Cincinnati section of the American Society of Mechanical Engineers. Other members of the executive committee of the Cincinnati section include: H. C. UIHLEIN, Cincinnati Engineering Tool Co.; WILLIAM F. GROENE, R. K. LeBlond Machine Tool Co.; GEORGE SEYLER, Lunkenheimer Co.; GEORGE LANGEN, Cincinnati Planer Co.; C. L. KOEHLER, Alvey-Ferguson Co.; WILLIAM H. VOCKELL, Cincinnati Engineering Tool Co.; and HARRY FELDBUSH, Worthington Pump & Machinery Corporation.

J C. McQuiston

D. J. Quammen

R. E. W. Harrison

ARTHUR ANDREWS has been appointed chairman of Burton, Griffiths & Co., Ltd., Montgomery St., Sparkbrook, Birmingham, England. F. W. TURRELL, who is also a managing director of B. S. A. Tools, Ltd., one of the firm's associated companies, takes over active control of Burton, Griffiths & Co., Ltd., and will be assisted by E. C. FARRELL who becomes sales director.

CHARLES GEORGE GARRARD was awarded the Edward Longstreth medal by the Franklin Institute on May 20 for his invention of a speed reducer. Mr. Garrard is a resident of Thorn, Dunstable, Bedfordshire, England. In 1921 he began the development of this speed changer, and in 1922, formed a company known as Garrard Gears, Ltd. A license has been granted to the Crocker-Wheeler Electric Mfg. Co. of Ampere, N. J., to manufacture these speed changers for the United States and Canada.

C. L. SAUNDERS, general advertising manager and purchasing agent of the Morse Chain Co., Ithaca, N. Y. (recently merged with the Borg-Warner Corporation), retired in April. Over fourteen years ago Mr. Saunders took charge of the Morse Chain Co.'s advertising and publicity. Before his association with the Morse Chain Co., he was, for ten years, consulting engineer and general contractor in Cleveland, Ohio. He was also connected, for seven years, with the National Carbon Co., of Cleveland, as consulting and research engineer. Mr. Saunders intends to take an extended vacation, following which he will resume his work as consulting, merchandising, and purchasing engineer, specializing on reports on mechanization.

Obituaries

F. G. KRETSCHMER, representative of several American machinery manufacturers in Germany, died at Frankfort a/M on June 15 in his seventieth year. Mr. Kretschmer opened the New York office of the Brown & Sharpe Mfg. Co. in 1893, after having served the Krupp interests during the Columbian Exposition. Later he returned to Germany, where he was associated with Diechmann & Co., representatives of many American machine tool firms. In 1905 he opened an office in Frankfort, where he represented a number of American companies up to the time of his death.

Einar Morin

Einar Morin, works manager and chief engineer of the Bofors Works, Bofors, Sweden, died recently at the age of forty-eight. Readers of MACHINERY who studied its pages some twenty years ago may recollect the comprehensive series of articles on the design of jigs and fixtures by Mr. Morin published at that time. These articles constituted the first comprehensive treatise on jig and fixture design published, and were later made the foundation of a book on this subject.

Mr. Morin was born in Sweden in 1883, and after having graduated from the engineering school of Boras in his home country, came to the United States in 1903, where he obtained a thorough practical experience in American shop methods at the plants of the Pratt & Whitney Co., Hartford, Conn., and the Pond Machine Tool Co., Plainfield, N. J. In 1908 he returned to Sweden. From that time on he held important positions with leading machine-building plants in Sweden, and in 1918, became works manager and chief engineer at Bofors, one of the largest plants in northern Europe. Building upon his early experience and training in the United States and supplementing this by the painstaking effort which always characterized his work, he became known as one of the ablest works managers in Scandinavia.

EDWARD W. PUTNAM, vice-president and general manager of the Kelly Reamer Co., Cleveland, Ohio, died in Springfield, Ohio, on June 1, from injuries received in an automobile accident.

Early Engineering Handbooks

One of the earliest engineering handbooks published in the United States was the well-known work of Haswell, the first edition of which appeared in 1843 and which in 1863 had already reached its fifteenth edition, at which time the book contained 316 pages. In the preface to this book, Mr. Haswell stated that "to the young engineer it is necessary to cultivate a knowledge of physical law, without which eminence in his profession can never be securely obtained."

Another early American engineering handbook, published in New York in 1848, was entitled "The Mechanical Principia," and contained, according to the title page, "all the various calculations on water and steam power and on the different machinery used in manufacturing, with tables showing the cost of manufacturing different styles of cotton goods." The author of this book was Charles Elbredge Leonard, and the publisher Leavitt, Trow & Co. The book contained 197 pages.

The following extract from the preface may be of interest: "The present work pretends to no other merit than that of being a laborious collection of the most useful calculations for the mechanic and manufacturer. All the various calculations on motive power have been condensed and arranged in as comprehensive a mode as possible, which are such as to enable the mechanic to obtain the solution of any problem simply by reference to the tables; hence, it will be seen that those mechanics who possess very little mechanical knowledge will be able to obtain the solution of the most intricate problem in mechanical science. All must readily admit that it requires no small amount of labor to perfect the present work, and that its design proposes a plan of arranging calculations which cannot fail to be very useful to the mechanic and manufacturer."

In 1871, J. C. Trautwine published his well-known "Civil Engineer's Pocketbook," which, exclusive of the index, contained 684 pages. Since that time a great number of engineering handbooks have appeared.

Among early English engineering handbooks may be mentioned the "Engineer's and Contractor's Pocketbook," a volume of 382 pages, published in 1847 in London.

One of the earliest French engineering handbooks was "Nouveau Manuel Complet de L'Ingenieur Civil," which was published in Paris in 1845, and consisted of two parts of about 500 pages each. Judging from the number of pages it might be thought that this was a very complete work, but as a matter of fact the size of the page was very small.

The earliest German engineering handbook of any importance was "Der Ingenieur," published by Julius Weisbach, in Braunschweig, Germany, in 1848. A second edition of this book, containing 607 pages, was published two years later.

* * *

A generator frame recently completed at the Westinghouse East Pittsburgh Works, which contained 82,000 pounds of steel, was entirely fabricated by the electric welding arc. This frame, constructed in three sections, was 25 feet in diameter and 67 inches high, and was part of a 66,700-kilovolt-ampere waterwheel generator.

Evening Course in Machine Design

About two years ago, Brown University instituted an evening course in machine design for apprentices, at the suggestion of the Brown & Sharpe Mfg. Co., Providence, R. I. It has now been announced that twenty students have just completed the course, among whom were a number of Brown & Sharpe apprentices. The course covers two years and is open to apprentices and others who have qualifications to take up the work. It was laid out from a purely analytical standpoint, and all problems are taken from machine tool practice. No attempt has been made to teach drafting, the purpose being to give a theoretical background for machine design approached from analytical practice. In order to encourage its apprentices, the Brown & Sharpe Mfg. Co. agreed to pay one-half of the tuition fee for those who completed the course with a satisfactory grade.

This is an interesting example of the sort of cooperation that is possible between manufacturers and educational institutions.

* * *

The National Automobile Chamber of Commerce, among its various activities, includes the cross-licensing of more than 1700 patents in the automotive industry, so that every manufacturer in the field may be able to make use of patents originating with another manufacturer. This has resulted in a tremendous development in the automobile industry, permitting the building of better automobiles and, at the same time, reducing manufacturing costs with resultant savings in the price.

News of the Industry

TURNER BRASS WORKS, Sycamore, Ill., announces a new "Blotorch" No. 30-A, designed especially for non-professional users and home mechanics.

VICTOR R. BROWNING & CO., INC., manufacturer of contractors' machinery and hoisting and conveying machinery, has removed its factory to 1320 E. 222nd St., Cleveland, Ohio.

HOWELL ELECTRIC MOTORS CO., Howell, Mich., announces that in the future all the company's "Red Band" motors will be provided with a new type of double sealed ball bearings.

AUTOMATIC ARC WELDING CO., 11 W. 42nd St., New York City, announces that the Babcock & Wilcox Co. has acquired non-exclusive licenses under the company's automatic arc-welding patents.

PORTER-CABLE MACHINE CO., Syracuse, N. Y., has appointed the Vandyck-Churchill Co., 52 Vesey St., New York City, representative for the sale of Porter-Cable lathes and milling attachments.

ROBBINS & MYERS SALES, INC., Springfield, Ohio, has appointed the Dravo-Doyle Co., Dravo Bldg., Pittsburgh, Pa., exclusive representative for the sale of Robbins & Myers hand and electric hoists, cranes, and trolleys in the Pittsburgh territory.

LUKENWELD, INC. (a division of the Lukens Steel Co.) Coatesville, Pa., has appointed W. R. McDonough & Co. representative of the company in the Cleveland district. The Dravo-Doyle Co. has been appointed representative in the Pittsburgh territory.

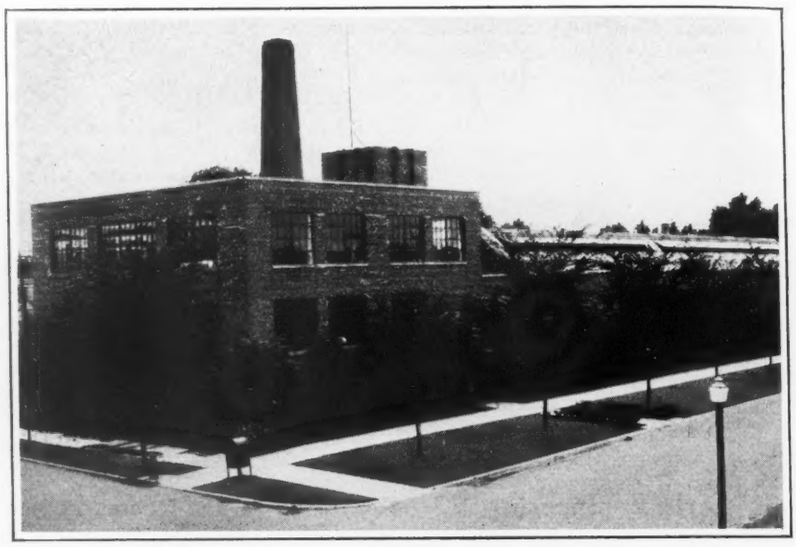
ERIE FOUNDRY CO., Erie, Pa., has adopted an interesting method of demonstrating the advantages of the company's Type M motor-driven board drop-hammers, as illustrated in the accompanying illustration. The model on the truck is patterned after a 3000-pound hammer, the dimensions being reduced in the ratio of 1 to 4.

EAGLE ENGINEERING CO., Springfield, Ohio, has recently acquired all the patent rights and equipment for the manufacture of the drill press vise formerly made by Demco, Inc., Baltimore, Md. This vise will be manufactured at the Springfield plant of the Eagle Engineering Co.

JOSEPH T. RYERSON & SON, INC., 16th and Rockwell Sts., Chicago, Ill., has acquired the entire interest in the Reed-Smith Co., Milwaukee, Wis., of which it had previously owned a part interest. The firm now becomes the Reed-Smith plant of Joseph T. Ryerson & Son of Wisconsin, Inc.

Method of Demonstrating Motor-driven Board Drop-hammers Adopted by the Erie Foundry Co., Erie, Pa.

MONARCH MACHINE TOOL CO., Sidney, Ohio, manufacturer of lathes, announces that in order to take care of the increased volume of business in the Chicago territory, an office and showroom have been opened at 547 W. Washington Blvd., Chicago, Ill. Martin J. Luther is in charge of the Chicago office.



A Successful Effort to Beautify the Surroundings of a Factory in a Large City—The Plant of the Kester Solder Co., Chicago, Ill.

CONSOLIDATED FOUNDRIES announce that the name of the company has been changed to GENERAL METALS CORPORATION, and the offices have been removed to 485 California St., San Francisco, Calif. The new organization will consist of three divisions, the foundry division, the forge division, and the machine division.

CUTLER-HAMMER, INC., 1295 St. Paul Ave., Milwaukee, Wis., announces that the Atlanta, Ga., sales office of the company has been moved to 133 Cone St., N. W. The new quarters include warehouse facilities, and a stock of C-H motor controls, wiring devices, and safety switches will be carried there for immediate delivery.

MONARCH MACHINE TOOL CO., Sidney, Ohio, during the last two months has staged six demonstrations of machine tools in as many large manufacturing centers, cooperating with the company's dealers in various cities. Each demonstration has lasted one week and covered tool-room lathes and the Monarch-Keller form-turning machines.

BRYANT CHUCKING GRINDER CO., 350 Clinton St., Springfield, Vt., announces the following new officers and directors: E. J. Fullam, president; W. J. Bryant, vice-president; J. E. Stetson, general manager; J. B. Johnson, assistant general manager; and A. L. Hicks, assistant treasurer. W. J. Bryant, E. J. Fullam, and J. B. Johnson have also been added to the directorate of the company.

For Most Efficient Production in the Free Cutting Steels . . .

Brown & Sharpe High Speed
Automatic Screw Machines
(Overhead Drive Type)

can be arranged with

30 SPINDLE SPEEDS

For the manufacturer producing primarily from steel, with occasional jobs in brass, or the reverse, these machines are particularly attractive. Instead of a machine for Brass—another for Steel—there can be obtained from the one machine the most efficient production rates for each material, saving appreciably in investment costs and floor space.

BROWN & SHARPE

BROWN & SHARPE MFG. CO. PROVIDENCE, R. I., U. S. A.

UNITED STATES CHAIN & FORGING Co., Union Trust Bldg., Pittsburgh, Pa., is now conducting its business under the name of the McKAY Co. It is stated that the change in name involves no change in personnel, policy, or organization. The company will continue to manufacture and distribute McKay steel and rubber tire chains and industrial chains for all purposes; automobile bumpers; and McKay "Anti-freeze."

LOUIS ALLIS Co., Milwaukee, Wis., manufacturer of direct- and alternating-current motors, announces the organization of a new sales company in California known as the Dodd Industrial Supply Co. The company will have offices in Los Angeles and San Francisco. Dodd Mauldin will be in charge of the Los Angeles office at 810 Santa Fé Ave., and R. D. McCrea will have charge of the San Francisco office at 648 Howard St.

CLEVELAND PNEUMATIC TOOL Co., Cleveland, Ohio, has appointed the Pittsburgh Auto Spring Co. distributor for the company's automotive products in Pittsburgh. J. W. Broughton, who has been distributor of these products in Pittsburgh for six years, has been made vice-president of the Pittsburgh Auto Spring Co. and will be director of sales and service for its complete line, including the Gruss air springs and multi-power brakes.

AMERICAN OXYCOP Co., formerly located at 430 E. Woodbridge St., Detroit, Mich., has moved to 117 Wellington St., West, Toronto, Canada. Bradley Machinery Co., 430 E. Woodbridge St., Detroit, represents the company in Michigan, and Scott-Bansbach Machinery Co., 4607 W. 20th St., Chicago, in Illinois and Wisconsin. It is planned to locate an office and factory in Buffalo, N. Y., for the manufacture of Oxy-Coal gas-flame cutting machines made under the patents of the Hancock Co. of Croydon, England.

CINCINNATI MILLING MACHINE Co., Cincinnati, Ohio, entertained 250 members of the Chicago Superintendents' and Foremen's Club, who made a special trip to Cincinnati on June 6 in order to inspect the plants of the Cincinnati Milling Machine Co., the Cincinnati Grinders, Inc., and the Foundry Division. Guides were appointed to take the guests through the plants and point out all the features of particular interest. Following the inspection tour, luncheon was served in the main dining room of the company. The trip ended with a tour of the city by bus.

NORTON Co., Worcester, Mass., manufacturer of grinding machines, grinding wheels, and abrasives, announces that plans have been made for a consolidation of the Norton Co. and the BEHR-MANNING CORPORATION, of Troy, N. Y., manufacturer of abrasive papers and cloths for machine and technical uses. It is planned to continue the operation of the two companies under their present names and managements, and with their present manufacturing and sales organizations. The different lines of abrasive products of these companies are in a great measure supplementary, so that the proposed consolidation will cover the entire abrasive field.

HUTTO ENGINEERING Co., INC., 515 Lycaste Ave., Detroit, Mich., announces the following changes in personnel, in connection with a reorganization of the company: Joseph A. Carlin, formerly receiver, is now general manager; Frank J. Jeschke has been appointed sales engineer; Ben O. Isom has returned to the company as factory representative for the Detroit and Chicago territories; William F. Toepfer has been appointed factory representative for the Philadelphia, New York, and Boston territories; J. L. Navin has been appointed field engineer for the Cleveland, Pittsburgh, Buffalo, Rochester, and Syracuse territories; James G. Young has been made overseas representative for the company, and will be located in Europe.

* * *

New Insulating Firebrick

The Babcock & Wilcox Co., Bayonne, N. J., has placed on the market a new insulating firebrick known as B. & W. No. 80 insulating firebrick. This is an entirely new material for furnace work and is said not only to be an insulator, but also to have all the qualities of the best kind of firebrick. It is stated that when used as linings for intermittent furnaces, the new material will produce great fuel savings during the heating-up periods. The brick may be used without a facing of firebrick on the furnace side, and may be exposed to furnace temperatures and gases by simply being protected with a coating of what is known as No. 80 high-temperature or patching cement. The new brick is suitable for lining oil- or gas-fired furnaces, electric furnaces of the resistance type, and for coal-fired equipment when it can be used in wall areas not exposed to abrasion and slag action.

* * *

The electric welding method has now extended to the construction of dwelling houses. A six-room, two-story dwelling at Larchmont Gardens, N. Y., has recently been constructed by electric arc welding. The entire framework and all interior partitions are made up of panel frames fabricated in the welding shop from 1 1/2 inch angles. An 8-inch I-beam is used for the main floor bearing beam. All floor joists are welded to the frame.

Coming Events

AUGUST 10-25—Meeting of the Industrial Institute at Silver Bay, Lake George, N. Y. The meeting embraces four industrial divisions as follows: Industrial supervision; plant training; personnel principles and methods; and conference of smaller industries. For further information, address Charles R. Towson, secretary, the Industrial Institute, 347 Madison Ave., New York City.

AUGUST 23-29—International Industrial Relations Congress to be held at Amsterdam, Holland. Further information may be obtained from Mary van Kleeck, Russell Sage Foundation Bldg., New York City.

SEPTEMBER 21-25—Annual meeting of the American Society for Steel Treating and National Metal Exposition to be held at the Commonwealth Pier, Boston, Mass. W. H. Eisenman, secretary, 7016 Euclid Ave., Cleveland, Ohio.

OCTOBER 7-8—Production Meeting of the Society of Automotive Engineers at the Book-Cadillac Hotel, Detroit, Mich. R. S. Burnett, Director, Production Activity, 29 W. 39th St., New York City.

OCTOBER 13-16—Twenty-fifth annual convention of the Illuminating Engineering Society at the William Penn Hotel, Pittsburgh, Pa. For further information, apply to the secretary, Illuminating Engineering Society, 29 W. 39th St., New York City.

NOVEMBER 10-12—National Transportation Meeting of the Society of Automotive Engineers, at Washington, D. C. Robert S. Burnett, director of transportation and maintenance activity, 29 W. 39th St., New York City.

NOVEMBER 30-DECEMBER 4—Annual meeting of the American Society of Mechanical Engineers at the Engineering Societies' Building, 29 W. 39th St., New York City. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

NOVEMBER 30-DECEMBER 5—First National Exposition of Mechanical Handling Equipment to be held at the Grand Central Palace, New York City. Charles F. Roth, Manager, International Exposition Co., Grand Central Palace, New York City.

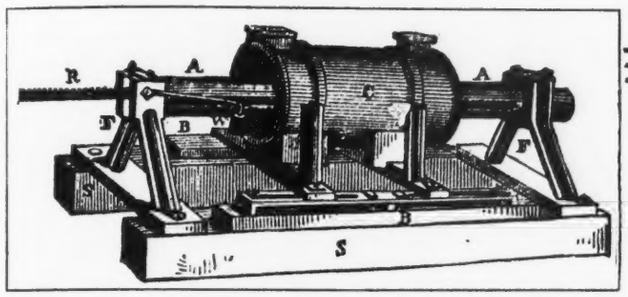
Societies, Schools and Colleges

AMERICAN STANDARDS ASSOCIATION, 29 W. 39th St., New York City. Year book for 1931, containing a review of the developments in national and international standardization during the past year. The book contains a list of the forty-six new national industrial standards that have been approved by the association during the year.

New Books and Publications

ABRASIVE GRAIN SIZES. 12 pages, 6 by 9 inches. Published by the U. S. Department of Commerce, Washington, D. C., as Simplified Practice Recommendation R118-30. Price, 5 cents.

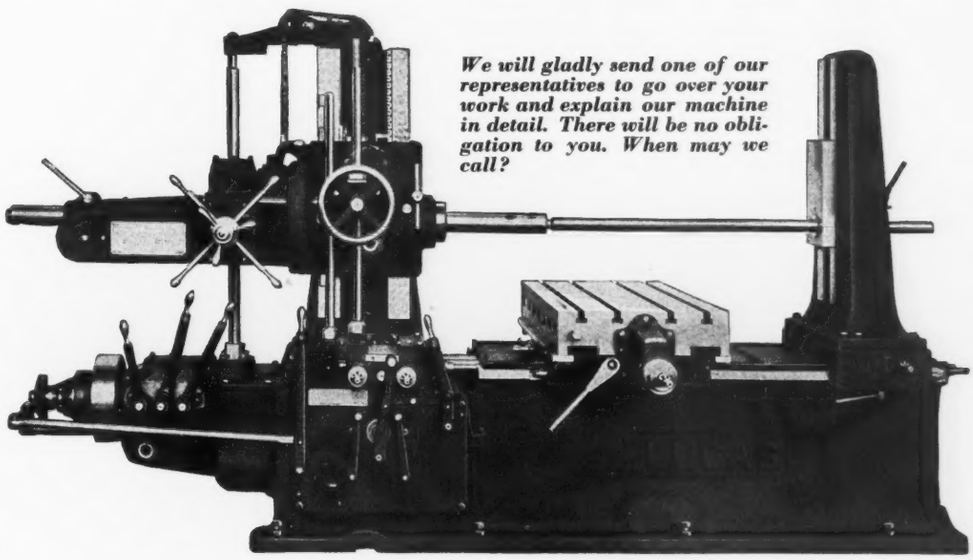
NEMA STANDARDS AND SPECIFICATIONS FOR VULCANIZED FIBER. 8 pages, 8 by 10½ inches. Published by the National Electrical Manufacturers Association, 420 Lexington Ave., New York. Price, 25 cents.



WILKINSON'S BORING MACHINE (1775) The first practical boring machine was built by John Wilkinson. Some of Watt's cylinders were bored on this machine to within 1/16 inch of true. Its importance cannot be overestimated as it insured the commercial success of Watt's steam engine which, up to that time, had not passed the experimental stage.

MACHINE TOOL EFFICIENCY

the foundation upon which our entire structure of industrial progress has been built



We will gladly send one of our representatives to go over your work and explain our machine in detail. There will be no obligation to you. When may we call?

Write NOW *for a descriptive circular of the*

Latest Type LUCAS

"Precision" Horizontal Boring Drilling and Milling Machine

THE LUCAS MACHINE TOOL CO.

CLEVELAND, OHIO

FOREIGN AGENTS: Allied Machinery Co., Barcelona, Zurich. Andrews & George Co., Tokyo. Catmur Machine Tool Corp., Ltd., London, Eng. M. Kocian & G. Nedela, Prague. V. Lowener, Copenhagen, Oslo, Stockholm. Emanuele Mascherpa, Milan, Italy. R. S. Stokvis & Zonen, Rotterdam, Paris.

Machine inventions, from the latter part of the 18th century down to the present day, have been the *framework* of our vast industrial progress, but the *foundation* of that progress has been the machine tool. Without a machine to bore the cylinders with some degree of accuracy, Watt's steam engine and Stephenson's locomotive could never have become practical. At that time, to bore within 1/16" of true was an achievement; now, accuracy to within a fraction of .001" is not unusual!

As accuracy improved, production became the problem. Machine tool builders solved it by making faster machines and simplifying their operation. That the automobile, in so short a time, has reached its present stage of amazing mechanical efficiency and volume production, is due largely to the steady advance in accuracy and speed of metal working tools.

The Lucas is an *outstanding* example of modern cutting tool efficiency, combining three major operations in one machine. Manufacturers who replace obsolete machines with the Lucas will set new records of economical production.

INSTRUCTIONS FOR CARE AND OPERATION OF TRANSFORMERS. Published by the Transformer Section of the National Electrical Manufacturers Association, 420 Lexington Ave., New York City. Price, 25 cents.

THE SAFE USE OF CUTTING OILS AND EMULSIONS. 8 pages, 8½ by 11 inches. Published by the National Safety Council, Inc., Civic Opera Building, 20 N. Wacker Drive, Chicago, Ill., as Safe Practices Pamphlet No. 44.

FURTHER MEASUREMENTS OF PROPELLER FAN CHARACTERISTICS. By P. S. Ballif and H. L. Dryden. 12 pages, 6 by 9 inches. Published by the United States Department of Commerce, Washington, D. C., as Research Paper No. 283 of the Bureau of Standards. Price, 10 cents.

INDUSTRIAL ACCIDENT STATISTICS. 39 pages, 8½ by 11 inches. Published by the National Safety Council, Inc., 20 N. Wacker Drive, Chicago, Ill.

This booklet presents a comprehensive national report on accident injuries in twenty-eight American industries for 1930 and previous years. The experience of nearly 4200 industrial establishments, representing more than 5,000,000,000 man-hours of work, is given.

MAKING THE DEALER AN ADVISER. 22 pages, 8 by 11 inches. Published by the Policyholders' Service Bureau of the Metropolitan Life Insurance Co., 1 Madison Ave., New York City.

This is one of the many publications issued by this bureau in the interest of better management in business. The present pamphlet treats of methods of obtaining cooperation from dealers, and contains a report on the experiences of nine organizations that have established dealer advisory councils as a means of strengthening their distributor relations.

THE PSYCHOLOGY OF THE INVENTOR. By Joseph Rossman. 252 pages, 6 by 9 inches. Published by the Inventors Publishing Co., 1266 New Hampshire Ave., Washington, D. C. Price, $3.

This book is of interest because it treats of a practically untouched field—the psychology of inventing. The author, in his capacity of patent examiner of the U. S. Patent Office, has acquired considerable insight into the psychological aspect of inventing and the mental processes of the inventor. In this book he has not only drawn upon his personal knowledge, but also on the experiences of over seven hundred prominent inventors. The material presented relates to methods of inventing, mental processes of inventors, difficulties to be avoided, relation of inventor to the promoter and purchaser, and experiences with the Patent Office and in Court.

HANDBOOK OF OIL BURNING. By Harry F. Tapp. 629 pages, 4¾ by 7½ inches; 358 illustrations. Published by the American Oil Burner Association, 342 Madison Ave., New York City. Price, $3.

The machinist or mechanical engineer whose work requires a knowledge of oil-burning heating or power equipment will undoubtedly be interested in this new handbook of oil burning. Charts, tables, and descriptive illustrations relating to every phase of the oil-burning industry are presented, and the various types of oil burners, their principles of construction, and controls are discussed in detail. A wide number of industrial and domestic oil burner applications are shown. In addition, a great deal of general information, such as the chemistry of combustion and flame, fundamentals of heat and heat transfer, the determination of heating capacity requirements, and comparative fuel costs is included.

FORD MODEL A AND AA TRUCK. By Victor W. Page. 703 pages, 5 by 8 inches; 318 illustrations. Published by the Norman W. Henley Co., 2 W. 45th St., New York City. Price, $2.50.

This is a revised and enlarged edition of a well-known handbook on the construction, operation, and repair of Ford cars and trucks. This edition contains four new chapters relating to all of the important changes that have been made in the Model A car up to January 1, 1931. Entirely new material has been added on the body construction, new electrical system parts, and all engine and chassis changes. A special chapter has been added fully describing the Model AA truck, and the new four-speed transmission, bevel drive, rear axle, and all changes in the chassis. Numerous suggestions for maintenance and repair have been added to the text, which should be of value to dealers and repairmen, as well as to the owner who makes his own repairs.

DYKE'S AUTOMOBILE AND GASOLINE ENGINE ENCYCLOPEDIA. 1339 pages, 7 by 10 inches. Published by the Goodheart-Willcox Co., Inc., 2009 S. Michigan Ave., Chicago, Ill. Price, cloth-bound, $6; flexible binding, $7.50.

This is the sixteenth edition of an encyclopedia covering the principles of construction, operation, and repair of automobiles and gasoline engines. The new edition contains many revised pages and considerable new matter. A great deal of the text dealing with the parts of early model cars and engines remains practically the same, because it illustrates fundamental principles. However, the text has been revised to cover the latest engineering improvements and developments in the construction of modern car chassis, engines, and accessories. The plan of the book is to present the information in the form of instructions in place of chapters. The idea is for a student to proceed systematically through the book, becoming familiar with each instruction before passing to the next. Thus he advances without difficulty from the simple principles to the more complicated processes. A table of contents and a complete cross-index are given for convenience in finding a particular subject. An insert is issued with the book dealing especially with the Ford Model A car.

New Catalogues and Circulars

ELECTRICAL EQUIPMENT. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Circular 1907, entitled "Steel Tank Mercury-arc Rectifier."

PUMPS. Northern Pump Co., Minneapolis, Minn. Bulletin PX2, containing data on Nitralloy steel pumps for fuel oil, kerosene, gasoline, and lubricating oil.

ELECTRICAL CONTROL EQUIPMENT. Electric Controller & Mfg. Co., Cleveland, Ohio. Circular descriptive of the new E C & M dynamic braking bridge-stop control.

NICHROME. Driver-Harris Co., Harrison, N. J. Catalogue containing full-page illustrations, showing a wide number of applications of Nichrome—a heat-resisting alloy.

CHAINS. Newhall Chain Forge & Iron Co., 9-15 Park Place, New York City. Pamphlet F-9110, showing a few of the many styles of heavy-duty sling chains made by this company.

BEARINGS. Robins Conveying Belt Co., 15 Park Row, New York City. Bulletin 81, descriptive of the construction of the Robins-Jones bearing for railway and mining service.

WELDING MACHINES. Thomson-Gibb Electric Welding Co., Lynn, Mass. Circular illustrating the use of a Thomson-Gibb welding machine for electrically welding pipe end to end.

ELECTRIC MOTORS. Reliance Electric & Engineering Co., Ivanhoe Road, Cleveland, Ohio. Bulletin 209, illustrating and describing in detail Reliance Type T heavy-duty motors for direct current.

TANTALUM. Fansteel Products Co., Inc., North Chicago, Ill. Circular describing the corrosion-resisting qualities of commercial tantalum and pointing out the uses for this metal in industry.

VISES. Eagle Engineering Co., Springfield, Ohio. Circular descriptive of the Eagle four-point drill press vise, which has recently been acquired by the company from Demco, Inc., of Baltimore, Md.

CRANES AND HOISTS. Victor R. Browning & Co., Inc., 1320 E. 222nd St., Cleveland, Ohio. Catalogue of electric overhead cranes and hoists, describing the various types and illustrating applications.

LOCK-NUTS. American Marsden Co., 1 Exchange Place, Jersey City, N. J. Circular descriptive of the construction, action, and application of the Marsden lock-nut, which is a standard one-piece lock-nut.

MERCURY GAGES. Amthor Testing Instrument Co., 309 Johnson St., Brooklyn, N. Y. Circular descriptive of the Amthor mercury column gage for accurate and close measuremept of low pressures and vacuum.

FLEXIBLE COUPLINGS. Morse Chain Co., Ithaca, N. Y. Circular illustrating and describing the Morse "Midget" flexible coupling, which is made in a range of sizes to suit all standard shaft diameters up to 1 inch.

LUBRICATING EQUIPMENT. Ideal Lubricator Co., Packard Bldg., Philadelphia, Pa. Pamphlet entitled "The Ideal System of Lubrication," describing a constant and controlled system for applying grease to bearings.

ELECTRIC FURNACES. H. O. Swoboda, Inc., 3400 Forbes St., Pittsburgh, Pa. Bulletin 260, illustrating and describing Falcon straight-line continuous electric furnaces for heat-treating ferrous and non-ferrous strip metal and wire.

BENDING MACHINES. Wallace Supplies Mfg. Co., 1310 Diversey Parkway, Chicago, Ill. Bulletin 27, illustrating and describing Wallace bending machines for the cold-bending of pipes, tubes, bars, angles, channels, and special sections.

ELECTRIC MOTORS. Louis Allis Co., Milwaukee, Wis. Bulletins 500-A and 508-A, illustrating and describing, respectively, multi-speed squirrel-cage alternating-current motors, and explosion-proof self-ventilated squirrel-cage motors.

DIE-PRESSED PARTS. American Brass Co., Waterbury, Conn. Bulletin outlining the advantages of the Anaconda method of producing irregular shaped parts of brass, copper, and high tensile strength bronze alloys by die-pressing or hot-forging.

CONVEYING EQUIPMENT. Cleveland Electric Tramrail Division of the Cleveland Crane & Engineering Co., Wickliffe, Ohio. Circular illustrating the application of the Cleveland overhead tramrail system for moving materials in the metal-working industry.

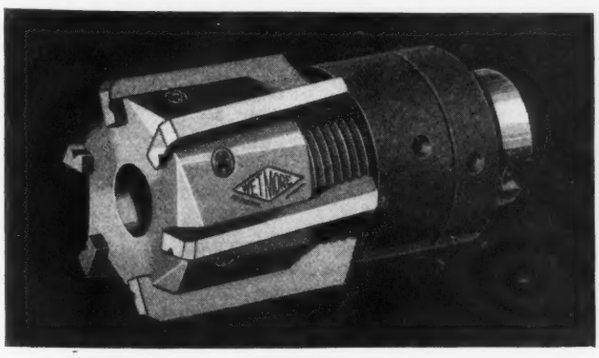
REAMERS. Goddard & Goddard Co., Detroit, Mich. Bulletin 103, illustrating the new Go & Go cam-lock expansion reamers. The principle of construction of these tools is explained, and tables of dimensions and price lists for the various sizes are included.

WETMORE

ADJUSTABLE REAMERS

Exclusive features of design and the care with which each reamer is manufactured have made Wetmore standard equipment in shops where the last word in precision is demanded. The name "Wetmore" on a reamer, like the Sterling mark on silver, is your positive assurance of 100 per cent accuracy, convenience of use, and unusually long life. Send for latest catalog of all types of Wetmore Adjustable Machine and Cylinder Reamers and replacement blades.

WETMORE REAMER COMPANY
412 NORTH 27TH STREET MILWAUKEE, WIS.



WETMORE TYPE NO. 7 SHELL REAMER

This reamer is also adaptable for bars or arbors in sizes 2 7/16" or over where one or more reamers are used at same time. Sizes range from 1¼" diameter to 6"; six, eight, ten, or twelve blades, depending on size. Left-hand angle blades prevent "digging in", chattering, and scoring while backing out.

DIE-HEADS AND THREADING MACHINES. Eastern Machine Screw Corporation, Truman and Barclay Sts., New Haven, Conn. Catalogue price list, covering the H & G line of self-opening die-heads, chasers, and threading machines for precision threading.

PUNCH PRESSES. Allsteel Press Co., 12015 S. Peoria St., Chicago, Ill. Bulletin AS-31, describing the Verson all-steel line of arc-welded steel plate punch presses. The bulletin describes the method of manufacturing these presses, and the advantages claimed for them.

MOTORS. Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis, Mo. Bulletin 165, covering seven distinct types of squirrel-cage motors and giving data on starting torques, starting currents, and cost. One section of the bulletin deals with multi-speed motors and control equipment.

GRINDERS. Ideal Commutator Dresser Co., Sycamore, Ill. Circular announcing the "Midget Model" precision grinder, designed especially for use on small commutators having a face width of 8 inches or less, as well as on medium size slip rings. This grinder is especially suitable for use in close quarters.

POWER TRANSMISSION EQUIPMENT. Baldwin-Duckworth Chain Corporation, Worcester, Mass. Bulletin 41, listing Baldwin stock sprockets with integral hubs, suitable for use with all pitches of chain from ⅜ inch to 2 inches, inclusive. List prices are given both for the sprockets and roller chains.

POTENTIOMETER PYROMETERS. Brown Instrument Co., 4485 Wayne Ave., Philadelphia, Pa. Catalogue 1101, describing the operating principle of a new line of Brown potentiometer pyrometers, and showing various styles. Folder illustrating a number of the new features of the Brown potentiometer pyrometer.

ALUMINUM PRODUCTS. Aluminum Co. of America, Pittsburgh, Pa. Card containing instructions for welding aluminum. The card is provided with an eyelet so that it can be hung up in the shop for ready reference. More detailed information on this subject is given in a booklet "Welding of Aluminum."

MOTORS. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Leaflet 20385-A, illustrating and describing the Type CS squirrel-cage induction motors equipped with sealed sleeve bearings. Attention is called to the fact that these new W-frame motors have interchangeable electrical and mechanical parts.

VIBRATION ISOLATION. L. Mundet & Son, Inc., 461 Eighth Ave., New York City. Circular illustrating and describing natural cork isolation mats used for deadening machine vibrations and noise. The circular gives the sizes in which these cork mats are available and contains directions for their installation.

BALL BEARINGS. S K F Industries, Inc., 40 E. 34th St., New York City. Bulletin 212, containing a general description and tabulated data covering S K F ball- and roller-bearing pillow blocks and shaft hangers. Catalogue 203, illustrating and describing in detail S K F preloaded ball bearings for precision spindles.

SPEED-CHANGERS. Crocker-Wheeler Electric Mfg. Co., Ampere, N. J. Circular descriptive of the new Crocker-Wheeler speed-changer, which can be used in conjunction with any standard Crocker-Wheeler motor to reduce or increase the speed of the driving shaft. Various applications of this speed-changer are illustrated.

SWIVEL PIPE JOINTS. Lapeer Engineering & Mfg. Co., Lapeer, Mich. Bulletin briefly describing the Lea swivel pipe joint, which has been designed for use on machines where cutting lubricants are required. The joint is so designed that it can be completely turned around as often as needed without danger of becoming loose or leaking.

WELDING EQUIPMENT. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Bulletin entitled "Westinghouse Arc Welding Data Bulletin No. 15," containing illustrations of many unusual arc-welding jobs. Various methods of testing are explained by the aid of diagrams, and methods of obtaining good welds are described.

FRICTION CLUTCHES. Carlyle Johnson Machine Co., Manchester, Conn. Catalogue containing data on the Super-Johnson friction clutch, which is made with a special heat-resisting facing on the friction ring surface. The various advantages of this type of clutch are pointed out, and the details of construction are illustrated.

STAINLESS STEEL. United States Steel Corporation, Frick Bldg., Pittsburgh, Pa. Booklet containing a treatise on U. S. S. stainless and heat-resisting alloy steels, issued by five of the subsidiary companies of the United States Steel Corporation. Tables of physical properties and recommended procedure for use are given for each different alloy.

WELDING MACHINES. Electric Arc Cutting & Welding Co., 160 Jelliff Ave., Newark, N. J. Circular announcing the Electroweld combination arc-welder and spot-welder, which is made in both portable and floor types. The machine is of all-steel construction, electrically welded throughout. It is made in various styles for different classes of service.

FORMING TOOLS. Weldon Tool Co., 321 Frankfort Ave., Cleveland, Ohio. Bulletin entitled "Wel-don Tools for Faster Cutting," showing departments in the company's plant where circular and flat forming tools are made and examples of the different types of tools. Catalogue 5, containing tables of dimensions and prices covering Wel-don end-mills.

NICKEL ALLOY STEEL. International Nickel Co., Inc., 67 Wall St., New York City. Catalogue entitled "Curtiss & Wright Engines and Their Use of Nickel Alloy Steel," containing a discussion of the principal features and service records of the complete Curtiss & Wright lines of airplane engines, with special reference to the materials used in their construction.

X-RAY SERVICE. Claud S. Gordon Co. X-Ray Laboratories, 708 W. Madison St., Chicago, Ill. Circular entitled "Secrets of Metal," outlining the X-ray service offered by this company. This comprises the X-raying of steel, iron, brick, clay, wood, and metals. Patterns, tools, dies, castings, raw material, and all shapes and sizes of steel, iron, and other metals can be X-rayed.

MAGNETIC CLUTCHES. Cutler-Hammer, Inc., 264 N. 12th St., Milwaukee, Wis. Booklet entitled "Keeping Pace with Machine Design," describing the construction, operation, and application of C-H magnetic clutches, including full details of the newly developed C-H duplex clutch. Many installation photographs are included, showing magnetic clutches applied to various types of machines.

METAL-CUTTING MACHINES. Racine Tool & Machine Co., 1752 State St., Racine, Wis. Catalogue 59, illustrating the Racine line of hydraulic metal-cutting machines known as "Hydraulic Shear Cut" machines. Three sizes of hydraulically controlled, reciprocating type, power hacksaws are illustrated, designed to handle stock 10 by 10 inches, 12 by 12 inches, and 10 by 16 inches in size.

THERMOSTATIC METALS. H. A. Wilson Co., 97 Chestnut St., Newark, N. J. Catalogue of Wilco Thermometals, which consist of two metals with different rates of thermal expansion permanently bonded throughout their contact surfaces. The difference in expansion of the members causes the bimetal to bend or deflect with changes in temperature. This deflection is utilized in thermostatic controls and indicating devices.

ALUMINUM PRODUCTS. Aluminum Co. of America, Pittsburgh, Pa. Pamphlet describing the properties, advantages, and application of aluminum die-castings. Catalogue containing data on aluminum screw machine products in the aircraft, automobile, textile, and many other industries. Structural aluminum handbook, intended to bring to the designer and builder the information needed for using aluminum structurally.

CONVEYOR BELTS. Diamond Rubber Co., Inc., Akron, Ohio. Booklet entitled "Belt Practice," containing considerable technical information on conveyor and elevator belts. The section on conveyor belt practice covers number of plies; horsepower; speed; capacity; thickness of covers; directions for installing; splicing; training the belt; operating conditions; repairs; orders and inquiries; and weights. Similar information is given for elevator belts.

DIE SETS. Danly Machine Specialties, Inc., 2104-2130 S. 52nd Ave., Chicago, Ill., Chart for selecting any of twenty different sizes and six different thickness combinations of die sets used for square, rectangular, and round dies. The chart is 17 by 11 inches, and has been drawn up especially for the use of those who want to keep it on the drafting-board or tack it up on the wall. By means of the sizes shown, it is possible to employ more than 1400 different combinations from these die sets.

BORING-BARS. Standard Boring Tool Co., Inc., St. Louis, Mo. (Warren S. Dunlap, distributor, 5107 Manchester Ave., St. Louis, Mo.) Bulletin 5, listing the outstanding features of Standard micrometer expansion Type S boring-bars, and giving tables of dimensions and prices of the various styles. The catalogue also gives prices and dimensions of replacement parts and expansion blocks for these boring-bars. A line of car-wheel boring-bars is also illustrated.

SMALL TOOLS. Eclipse Counterbore Co., Detroit, Mich. Catalogue 32, covering the complete line of Eclipse high-production tools, including counterbores, countersinks, spot-facers, two-piece core drills, multi-diameter cutters, end-form cutters, die-sinking cutters, and special tools. In addition to dimensions, prices, and other data relating to the various tools, there is a section containing illustrations showing a wide variety of applications of Eclipse tools in plants throughout the United States and Europe.

ELECTRIC CONTROLLING APPARATUS. Allen-Bradley Co., 1331 S. First St., Milwaukee, Wis. Bulletins G-1, 201, 609, 701, 705, 709EP, 710, 710DT, 710WT, 712, 720, 720DT, 720WT, 830, and 840, descriptive of automatic across-the-line switches of various types; direct-current contactors; hand-operated starting switches; alternating-current contactors; alternating-current reversing switches; automatic pressure switches; and automatic float switches. Price lists have also been issued to go with these bulletins.

BALL AND ROLLER BEARINGS. Aetna Ball Bearing Mfg. Co., 4600 Schubert Ave., Chicago, Ill. Handbook on ball thrust and radial roller bearings for designers and engineers. This catalogue, which is in its ninth edition, shows a number of interesting applications of these bearings, together with typical mountings. A number of formulas are presented for calculating horsepower, torque, and end thrust of worms and gears, and end thrust of bevel gears. The complete line of Aetna thrust bearings, retainers, and roller bearings is described in condensed form.